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FEASIBILITY STUDY ADDENDUM SITE 1 FORMER DRUM MARSHALLING AREA NWIRP BETHPAGE NY

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TETRA TECH

Feasibility Study Addendum

Site 1 – Former Drum Marshalling Area

Naval Weapons Industrial Reserve Plant
Bethpage, New York

Mid-Atlantic Division
Naval Facilities Engineering Command

Contract No. N62470-08-D-1001
Contract Task Order WE62, and
Contract No. N40085-12-1717
Contract Task Order 08

June 2016

FEASIBILITY STUDY ADDENDUM

SITE 1 – FORMER DRUM MARSHALLING AREA

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

Submitted to:
Naval Facilities Engineering Command Mid-Atlantic
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Norfolk, Virginia 23511-3095

Submitted by:
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In support of:
N62470-08-D-1001, Contract Task Order WE62, and
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ACROYNMS AND ABREVIATIONS

µg/kg	microgram per Kilogram
µg/L	microgram per liter
AGC	Annual Guideline Concentration
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
AS/SVE	air sparge/soil vapor extraction
AST	aboveground storage tank
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFM	cubic feet per minute
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMS	Corrective Measures Study
CMI	Corrective Measures Implementation
COC	chemical of concern
CSM	Conceptual Site Model
CTE	central tendency exposure
CTO	contract task order
DOD	Department of Defense
DOE	Department of Energy
DAR	Department of Air Resources
DERP	Defense Environmental Restoration Program
EE/CA	Engineering Evaluation/Cost Analysis
ERP	Environmental Restoration Program
FR	Federal Register
FS	Feasibility Study
GAC	granulated activated carbon
GPM	gallon per minute
GOCO	government owned, contractor operated
GRA	general response action
HDPE	high density polyethylene
HHRA	Human Health Risk Assessment
HNUS	Halliburton NUS
HQ	hazard quotient
HRS	Hazard Ranking System
IAS	Initial Assessment Study
IDW	investigative derived waste
ILCR	Incremental Lifetime Cancer Risk
IRM	interim remedial action
J	estimated value
LUC	land use control
MCL	maximum contaminant level
mg/kg	milligram per kilogram
mgd	million gallon per day
msl	mean sea level
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NG	Northrop Grumman
NOAA	National Oceanic and Atmospheric Administration

ACROYNMS AND ABREVIATIONS

NPDWR	National Primary Drinking Water Regulations
NTCRA	non-time-critical removal action
NWIRP	Naval Weapons Industrial Reserve Plant
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
ONCT	Onsite Containment System
OU	Operable Unit
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PP	Proposed Plan
PPE	personnel protective equipment
PRG	preliminary remediation goal
PRAP	Proposed Remedial Action Plan
PV	present value
PVC	polyvinyl chloride
RAO	remedial action objective
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RSL	Regional Screening Levels
SARA	Superfund Amendments and Reauthorization Act
SCO	Soil Cleanup Objective
SI	Site Inspection
SGC	Short-term Guideline Concentration
SPCC	Spill Prevention, Control, and Countermeasures
SVE	Soil Vapor Extraction
SVOC	semi-volatile organic compound
SVPM	soil vapor pressure monitor
SWMU	solid waste management unit
TAGM	Technical and Administrative Guidance Memorandum
TBC	to be considered
TCE	trichloroethene
TCRA	time-critical removal action
TPH-DRO	total petroleum hydrocarbons – diesel range organics
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage, and Disposal
TT	Tetra Tech, Inc.
TTNUS	Tetra Tech NUS
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

1.0 INTRODUCTION

This Feasibility Study (FS) Addendum for Site 1 – Former Drum Marshalling Area at Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, New York (Figures 1-1 and 1-2) was prepared by Tetra Tech Inc. (Tetra Tech) for Naval Facilities Engineering Command (NAVFAC) – Mid-Atlantic under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62470-08-D-1001, Contract Task Order (CTO) WE62 and N40085-12-D-1717, Task Order 08. This document is an addendum to the 1994 FS that addressed the previously identified extent of shallow polychlorinated (PCB) - contaminated soil at Site 1 to support the 1995 Operable Unit No. 1 (OU1) Record of Decision (ROD)(Halliburton NUS, 1994; NAVFAC, 1995). This FS Addendum has been prepared to address the PCB impacts to the deep soil and groundwater at the site that were not known at the time of the 1995 OU1 ROD and that were found during supplemental investigations. In addition, this FS addresses residual volatile organic compounds (VOCs) in site soil and metals in the groundwater. The addendum was developed based on data and evaluations presented in the Remedial Investigation (RI) Addendum – Soil, Groundwater, and Soil-Vapor for Site 1 – Former Drum Marshalling Area (Tetra Tech, 2015).

This FS Addendum specifically addresses the following:

- PCBs in soils from ground surface to 65 feet below ground surface (bgs). The 1995 ROD addressed PCB-contaminated soil to depth of 7 feet bgs that totaled 1,400 cubic yards;
- Residual PCB-contaminated soil associated with Dry Wells 20-08 and 34-07, which were added to Site 1 because of proximity and similarity in chemicals of concern (COC), concentrations, and depth;
- PCB- and metal (hexavalent chromium)-contaminated groundwater associated with Site 1, which was not addressed in the 1995 OU1 ROD (NAVFAC 1995) or the 2003 OU2 ROD (NAVFAC, 2003);
- Polynuclear aromatic hydrocarbons (PAH)- and metal-contaminated soil, which was identified in the 1995 OU1 ROD and is being considered in this FS Addendum because they are generally co-located with the PCBs and VOCs; and
- VOCs in Site 1 soil vapor that could result in vapor intrusion. The 1995 ROD did not address soil vapor intrusion as a pathway.

NWIRP Bethpage was a government-owned, contractor-operated (GOCO) facility leased by the Navy to Northrop Grumman (NG) from 1942 until the late 1990’s for the development and testing of naval combat aircraft. Site 1 is on the 9 acre parcel being retained by the Navy to complete environmental investigation and remediation (Figure 1-2).

Site 1 is an open area that previously included above ground storage tanks [Area of Concern (AOC) 23], sanitary settling tanks, approximately 120 sanitary cesspools receiving Plant 3 sanitary wastewater discharge, and sludge drying beds. Cadmium and cyanide wastes, halogenated and non-halogenated solvents, transformers, and PCB-fluid based autoclaves were stored at Site 1. In 1982, drummed waste storage was transferred to the covered Drum Marshalling facility located at Site 3 - Salvage Storage Area, (Figure 1-2).

Based on the 2015 RI Addendum, Site 1 soils are contaminated with PCBs, metals, semi-volatile organic compounds (SVOCs) and chlorinated VOCs. Groundwater is contaminated with PCBs, metals, and chlorinated VOCs. Chlorinated VOC contamination in groundwater is being addressed by the OU2 ROD (NAVFAC, 2003).

1.1 REGULATORY BACKGROUND

This work is part of the Navy's Environmental Restoration Program (ERP), which identifies contamination of Navy and Marine Corps lands and facilities resulting from past operations, and to implement responses as necessary under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Defense Environmental Restoration Program (DERP), 10 U.S.C. Secs 2701 – 2711 (2016). There are four distinct phases under CERCLA. Phase 1 is the Preliminary Assessment (PA), which was formerly known as the Initial Assessment Study (IAS). During this phase, background information is collected to determine whether additional evaluation is warranted. Phase 2 is the Site Inspection (SI), during which limited data collected may be conducted to evaluate the extent of potential threats to human health or the environmental. Phase 3 is the RI/FS, which characterizes the contamination at a facility and develops options for remediating the site. Phase 4 is the Remedial Action, which results in the control or cleanup of contamination at sites. This report has been prepared under Phase 3.

When NWIRP Bethpage was operational, it was a large quantity generator of hazardous waste, and was classified as a Treatment, Storage, and Disposal (TSD) facility for storage of hazardous wastes beyond 90 days. Due to this designation, NWIRP Bethpage was issued a permit under the Resource Conservation and Recovery Act (RCRA) [United States Environmental Protection Agency (USEPA) ID NYD002047967] and New York State Department of Environmental Conservation (NYSDEC) 6 New York Code, Rules, and Regulations (NYCRR) Part 360, in which the Navy was identified as the property owner and NG was listed as the operator. NG's cleanup on its former manufacturing property is also subject to this permit.

NWIRP Bethpage is also classified as an "Inactive Hazardous Waste Disposal Site" under NYSDEC 6 NYCRR Part 375 (Registry No. 1-30-003B). The Part 375 program is a risk-based program and closely parallels the USEPA Superfund Program.

To address these requirements for this site, environmental investigations are being conducted under CERCLA and managed in accordance with the Navy's ERP. Therefore, CERCLA authority is used to address CERCLA response actions and RCRA correction action requirements. The Navy is the lead federal agency under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulation (C.F.R.) Part 300, and Executive Order 12580, as amended by Executive Order 13016, for CERCLA response activities at NWIRP Bethpage. Both CERCLA and RCRA share the goal of protecting human health and the environment, and address substantive RCRA and State hazardous waste law requirements through CERCLA's cleanup standard (ARARs) process. Any procedural differences between CERCLA and RCRA should not substantially affect the outcome of cleanup. A comparison of steps for each program is presented below (NAVFAC, 2006).

Comparison of CERCLA Response Actions and RCRA Corrective Actions at Federal Facilities	
CERCLA Response Action[1]	**RCRA Corrective Action**[2]
Preliminary Assessment/Site Inspection (PA/SI) • Preliminary Assessment (PA), formerly known as the Initial Assessment Study (IAS). • Hazard Ranking System (HRS) Scoring. • Site Inspection (SI).	**RCRA Facility Assessment (RFA)** • Preliminary Review. • Visual Site Inspection. • Sampling Visit.
Removal Action[3] • Emergency Removal Actions. • Time-Critical Removal Actions (TCRAs). • Non-Time-Critical Removal Actions (NTCRAs).	**Interim Measures**[3] • Interim Remediation. • Temporary Fixes. • Alternate Water Supplies.
Remedial Investigation (RI) • Site-Specific Data Collection. • Source Characterization. • Contamination Characterization. • Waste Mixtures, Media Interface Zones. • Hydrogeological and Climate Factors. • Risk Assessment. • Potential Routes of Exposure. • Extent of Migration.	**RCRA Facility Investigation (RFI)** • Background Data Review. • Environmental Setting Investigation. • Sources Characterization. • Contamination Characterization. • Potential Receptors Characterization.
Feasibility Study (FS) • Define Objectives and Nature of Response. • Develop Alternatives. • Conduct Detailed Analysis of Alternatives.	**Corrective Measures Study (CMS)** • Identify and Develop Alternatives. • Evaluate Alternatives. • Justify & Recommend Corrective Measure.
Remedy Selection • Select Remedy Which Meets Nine NCP Criteria. • Proposed Plan (PP). • Record of Decision (ROD).	**Remedy Selection** • Select Remedy that Abates Threat to Human Health and the Environment.
Remedial Design/Remedial Action • Design Remedy. • Perform Remedial Action. • Perform Operations and Maintenance and Monitoring.	**Corrective Measures Implementation (CMI)** • Develop Implementation Plan, Program, and Community Relations Plan. • Corrective Measures Design. • Construction and Implementation.

1. CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986 and implemented by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The NCP (40 CFR Part 300) was originally established to respond to oil spills. However, following issuance of the Clean Water Act of 1972 (CWA), the NCP was broadened to include actual and potential hazardous substance releases.
2. 2. RCRA as amended by the Hazardous and Solid Waste Amendments of 1984, the Federal Facility Compliance Act of 1992, and the Land Disposal Program Flexibility Act of 1996. U.S. Code (USC) Title 42, Section 6901 (42 USC 6901) et seq. RCRA Subtitle C (Hazardous Waste Regulations; Code of Federal Regulations [CFR] Title 40, Parts 260 through 279 [40 CFR 260-279]) establishes a system for controlling hazardous waste from the time it is generated until its ultimate disposal (from "cradle to grave").
3. Removal Actions and Interim Measures may be implemented at any point during the Response Action or Corrective Action processes.

1.2 OBJECTIVES AND APPROACH

This document is developed to serve as an FS Addendum under CERCLA in accordance with USEPA FS guidance (USEPA, 1988). This FS Addendum includes a comparative analysis of remedial alternatives that will support the selection of a preferred remedy. The Navy works with the State to select a preferred remedy pursuant to CERCLA, and will provide the public opportunity to comment on a CERCLA Proposed Plan (PP). After considering public comments, the Navy will prepare the amendment to the 1995 Record of Decision (ROD).

This FS uses the conceptual site model (CSM) generated during the CERCLA RI Addendum, and previous investigations to develop remedial action objectives (RAOs), preliminary remediation goals (PRGs), and an evaluation of remedial alternatives. A list of chemicals of concern (COCs) for site soils and groundwater (Section 3.0) is based on exceedances of risk to human health and/or applicable federal and/or state criteria. This report discusses criteria used to evaluate remedial alternatives to determine the benefits of implementing them. Evaluation criteria are described in Section 5.0 as they apply to each alternative technology.

Under the CERCLA FS process, the remedial alternatives are evaluated according to their ability to meet the following criteria:

Threshold Criteria:

1. Overall Protection of Human Health and the Environment
2. Compliance with Applicable or Relevant and Appropriate Requirements

Balancing Criteria:

1. Long-term Effectiveness and Permanence
2. Reduction of Toxicity, Mobility, or Volume Through Treatment
3. Short-term Effectiveness
4. Implementability
5. Cost

In addition, state and community acceptance are evaluated after regulatory and public comment on the FS Addendum. Sustainability elements (e.g., green remediation) are considered during evaluation of the remedial alternatives (refer to Section 5). The information presented herein will be used by the Navy, as the federal lead agency, in cooperation with State and local officials, to select remedial alternative(s) that comply with CERCLA requirements. This FS Addendum is not intended to serve as a design document; rather, it gives a conceptual overview of remedial alternatives and an assessment of their feasibility.

The Navy maintains a public repository, which includes supporting technical documents and correspondence related to the site and NWIRP Bethpage, at the following location:

Bethpage Public Library
47 Powell Avenue
Bethpage, New York 11714
(516) 931-3907

A public web site with the Administrative Record can be accessed at the following web page:

http://go.usa.gov/DyXF

1.3 REPORT ORGANIZATION

This report is organized as shown in the Table of Contents. Tables and figures are provided at the end of the document.

2.0 SITE BACKGROUND

This section provides a summary of background information for NWIRP Bethpage, Site 1. This section also summarizes previous environmental investigations and actions that occurred at the site. Additional information may be found in the various reports referenced in this section, which are available in the Administrative Record.

2.1 FACILITY INFORMATION

NWIRP Bethpage is located in Nassau County on Long Island, New York; approximately 30 miles east of New York City (see Figure 1-1). The facility that would later become NWIRP Bethpage was established in 1942 for the research prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. Site 1 is situated along the eastern boundary of the former NWIRP Bethpage (see Figures 1-2 and 2-1).

NWIRP Bethpage was a Government-Owned, Contractor-Operated facility that was operated by NG until 1996. As a result of NG's decision to terminate operations at NWIRP Bethpage, the U.S. Congress passed special legislation (PL 105-85 Sec 2852 FY-1998) that was issued as a part of the National Defense Authorization Act of 1998, authorizing conveyance of the Navy's real property at NWIRP Bethpage to Nassau County, New York for economic redevelopment. NWIRP Bethpage originally included a main parcel of approximately 105 acres and a separate parcel of approximately 4.5 acres located to the north of the main parcel.

In 2002, the Navy transferred the 4.5 acre parcel to Nassau County (NAVFAC, 2002). On February 26, 2008, the Navy transferred 96 acres of the 105-acre main parcel to Nassau County and is leasing the remaining 9 acres to Nassau County (NAVFAC, 2008). Two sites located on the main parcel that were transferred, Site 2 – Recharge Basins and Site 3- Salvage Storage Area, were determined to require land use controls (LUCs) and Five-Year Reviews as a part of the selected remedy (Figure 2-1). These LUCs are in place and reviews are being conducted, as required. The 9-acre parcel that the Navy retains includes Site 1 – the Former Drum Marshalling Area and Site 4 – Former Underground Storage Tank area. These sites are being kept by the Navy for environmental investigation and remediation. Upon successful remediation of the 9-acre parcel, it will also be transferred to Nassau County. The transfer and lease documents provide land use controls and notifications of areas in which residual contamination is present.

In 2011, Steel-Los III, LP bought 84 acres of the 96-acre property from Nassau County and has been renovating the property to attract new tenants. Nassau County has retained the remaining 12 acres for economic development. The Navy-owned 9-acre parcel was also subleased by Nassau County to Steel-Los III, LP in 2011. Steel-Los III currently utilizes the owned and leased properties for light industrial and commercial activities, miscellaneous outdoor storage, and as a movie production set. Steel-Los III, LP maintains security for the facility.

2.1.1 Surface Features

NWIRP Bethpage is located on a relatively flat, featureless, glacial outwash plain. The site and nearby vicinity are highly urbanized. Most of the natural physical features have been reshaped or destroyed. Dominant building features include Plant No. 3 to the west of Site 1, and the Plant 17 South Warehouses to the south of Site 1. The topography is relatively flat with a gentle slope towards the south. The elevation at Site 1 ranges from 125 feet mean sea level (msl) to the north to 116 feet msl to the south. A 4-foot vegetated windrow (pine) and perimeter fence are present along the eastern edge of the site to reduce community visibility and provide security. The perimeter fence also surrounds the site on the northern and southern edges, with an interior facility fence along the western edge. Two additional berms at an elevation of 130 feet msl are located at the northwest portion, and eastern side, respectively, of Site 1. The site is mounded to the north to partially bury the abandoned sanitary settling tank. In 2009, the upper six feet of the settling tank was removed. In 2012, a section of the southern half of Site 1 was paved with asphalt and/or gravel mix, and the vegetated windrow in the eastern portion of Site 1 was extended further south. The site has limited drainage features, including three recharge basins located north of Site 1.

2.1.2 Surrounding Land Use

The land surrounding the Bethpage facility in all directions is primarily industrial. Site 1 remains unused and the majority of the site is surrounded by a fence. Operations at the site are currently limited to environmental investigations, control of vegetation, fence repair, security patrols, and fire watch and/or suppression. Security is present at the facility during the week days and evenings.

Site 1 was surrounded by the large NG complex of research and development centers, manufacturing and assembly plants, test facilities, and corporate headquarters. Suburban housing surrounds much of the former NG land. These densely-populated developments include the town of Bethpage, Levittown, Hicksville, and Plainedge.

A railroad, commercial and light industrial operations, and the Broadway-Hicksville-Massapequa Road flank the NWIRP on the western side. Route 135, the Seaford-Oyster Bay Expressway, lies one mile east of the NWIRP. Bethpage State Park, with its extensive golf courses, abuts the expressway on the opposite side.

2.1.3 Climate and Meteorology

NWIRP Bethpage is located in an area described as a humid, continental climate. Its proximity to the Atlantic Ocean adds maritime influences, and prevailing westerly winds result in a modified continental climate on Long Island (NOAA, 1982). Data from Republic Airport (KFRG), located in Farmingdale, New York, shows that the winter average temperature for Nassau County is 33 degrees Fahrenheit, compared to a summer average temperature of 72 degrees Fahrenheit. The total annual precipitation is 42 inches. Of this, 21 inches usually falls between the months of April and September. The average seasonal snowfall is 27 inches.

2.1.4 Previous Site Use

From approximately the early 1950s until 1978, drummed wastes were stored at Site 1 in a cinder-covered area located over the cesspool field. In 1978, the drum storage area was relocated to the south to a 100- by 100-foot concrete pad, also located over the cesspool field. This pad had no cover or spill containment. In 1982, the drum storage area was moved to a covered storage area, located at Site 3 (Salvage Storage Area). Approximately 200 to 300 drums were stored at Site 1 at any one time. The drums reportedly contained halogenated and non halogenated solvents, cadmium, and cyanide wastes. During the early 1990's transformers that potentially contained polychlorinated biphenyls (PCBs) and autoclaves were also stored on the ground at Site 1.

Until 1968, the cesspool field received sanitary waste waters from Plant 3, west of Site 1. There were approximately 120 cesspools in total, now abandoned, that were approximately 10 feet in diameter and 16 feet deep. The cesspools were open-bottom and are now filled with soil.

Starting in 1969, hazardous waste management practices for NG activities on Long Island included marshalling of drummed wastes at Site 1. Reportedly, waste drums were taken off-site by a private contractor for treatment and disposal.

In addition to the cesspool field, the sanitary settling tank, which is Area of Concern (AOC) 23, were used to treat sanitary waste from 1942 until 1968. This sanitary settling tank separated solid and liquid wastes. Liquid wastes were then discharged to the series of cesspools at Site 1. The other component to the sanitary waste treatment system was AOC 35, which included four sludge drying beds. Sludge was conditioned, dewatered, and dried prior to off-property removal. The sludge drying beds were closed and backfilled in 1980.

Along the western edge of Site 1, two underground storage tanks (USTs), AOC 32, were used to store bulk quantities of tetrachloroethene (PCE). The tanks were no longer used after the early 1980's and were initially abandoned in place. In 2012, the USTs and their contents were removed when they were encountered during construction activities.

Dry-wells 20-08 and 34-07 were part of the storm water management system that functioned as catch basins for storm water overflow which ultimately discharged to the recharge basins north of Site 1. PCB fluids may have entered the cesspools through the storm sewers and then flowed into the underlying soils through permeable well bottoms. Both dry wells are no longer in use and have been abandoned. These dry wells, because of proximity and similarity in COCs, were added to Site 1.

2.2 GEOLOGY

NWIRP Bethpage is underlain by approximately 1,100 feet of unconsolidated sediments that overlie crystalline bedrock (Isbister,1966). The unconsolidated sediments consist of four distinct geologic units: the Upper Glacial Formation; Magothy Formation; Raritan Clay; and Lloyd Sand Formations (McClymonds and Franke, 1972). The Upper Glacial Formation (glacial deposits) forms the surface deposits across the entire NWIRP. This formation consists primarily of coarse sands and gravels, and is approximately 30 to 45 feet thick. Variations in the thickness of the glacial deposits are common due to undulating contact with the underlying Magothy Formation. The Upper Magothy Formation consists primarily of coarse sands to a depth of approximately 100 feet, below which finer sands, silts, and clay predominate. Individual clay units significantly increase below subsurface depths of 100 feet, but are laterally discontinuous; no individual clay horizon of regional extent underlies the facility in the Magothy. The 100- to 150-foot thick Raritan Clay Formation underlies the Magothy Formation at a depth of approximately 700 to 800 feet bgs. The underlying Lloyd Sand Formation is approximately 300 feet thick.

2.3 HYDROGEOLOGY

Most of Long Island is bisected by an east-west-trending regional groundwater divide. NWIRP Bethpage occupies an area of recharge, lying south of the divide. Groundwater is in contact with the Upper Glacial and Upper Magothy Formations beneath the facility. With limited distinction between the formations, groundwater may be considered a common unconfined aquifer. The glacial deposits underlying the facility are characterized by a high porosity (in excess of 30 percent). The high permeability of the glacial deposits allows for rapid recharge of the Magothy Formation from precipitation (Isbister, 1966; McClymonds and Franke, 1972). The number and thickness of clay lenses increase with depth in the Magothy Formation; however, these units are laterally discontinuous and do not function as a confining unit within the aquifer.

Groundwater beneath the facility flows in a general southerly direction toward the Atlantic Ocean. Across the facility the average horizontal hydraulic gradient and groundwater velocity of the unconfined aquifer are 5.3 feet per mile and 0.3 foot per day, respectively [Halliburton NUS (HNUS), 1993]. Higher groundwater velocities can occur in gravel zones and/or in response to pumping stresses. Subtle vertical hydraulic gradients occur in a downward direction. Groundwater in the Magothy Formation is considered a sole source aquifer (NYSDEC Class GA), and is the primary source of potable water for Nassau County. Groundwater is encountered at a depth of approximately 50 feet bgs at the facility. In the past, due to pumping via deep production wells at the facility, and recharge, groundwater has been measured at depths from 40 to 60 feet bgs.

From the 1960s to the 1990s, 16 deep production wells (7 on NWIRP and 9 on Grumman property) were in operation at the facility. The wells were screened within the Magothy Formation and each yielded approximately 1,200 gallons per minute (gpm). All of the production wells on Navy property and most of the production wells on the NG property have been decommissioned. Extracted water was used primarily for non-contact single pass cooling for operations on Navy and NG properties. Based on extraction and recharge rates and well locations, groundwater on the Navy property flowed predominantly west and southwest. Production wells extracted groundwater from depths of approximately 280 to 500 feet bgs. Water was discharged into nearby surficial recharge basins. The extraction from the production wells and near surface recharge resulted in vertical gradients across the Site that would enhance the downward migration of COCs. Currently, two of the NG production wells and three containment wells operate with a combined flow rate of approximately 3,800 gpm or 5.5 million gallons per day (mgd)(ONCT System). This system would limit the migration of COCs south of these extraction wells.

The Magothy aquifer is highly conductive. Based on water level measurements in 2010 to 2013, groundwater across Site 1 flows to the south-southeast and the elevation ranges from approximately 73 to 70 feet mean sea level (msl).

2.4 PREVIOUS RESPONSE ACTIVITIES

In 1993, NG covered portions of Site 1 with soil to control potential risk from fugitive dust emissions or dermal contact with PCB-contaminated soil.

In 1998, NG conducted a soil removal action at Dry Wells 20-08 and 34-07, to a depth of 28 feet bgs or 30 feet bgs, (there are conflicting NG reports). Confirmation samples collected at the bottom of the excavations exhibited PCB concentrations of 1,800 milligram per kilogram (mg/kg) (or 1,900 mg/kg) at Dry Well 20-08 and 25,000 mg/kg at Dry Well 34-07. Subsequent testing conducted by NG in 1998 determined that PCBs extended down to near the water table at a depth of approximately 54 to 56 feet bgs. Additional testing by NG in 1999 confirmed PCB-impacted soil at depths up 65 feet bgs.

The Navy installed and operated an air sparging/soil vapor extraction (AS/SVE) system 1998 to 2002 to treat VOC-contaminated soil, and removed approximately 4,500 pounds of VOCs. In 2001, an evaluation of groundwater contamination beneath Site 1 was conducted to assess AS/SVE system performance and its related impact on groundwater. VOCs were detected in groundwater throughout most of the southern portion of Site 1; however, there was significant variation in the concentrations and distribution of individual compounds (Foster Wheeler, 2001). Trichloroethene (TCE) was the most predominant COC, detected at concentrations ranging from 2.4 to 230 micrograms per liter (µg/L). The system was removed in 2003 (Foster Wheeler, 2003).

In 2008, the Navy initiated a soil vapor intrusion investigation to evaluate potential risks to the residential neighborhood east and adjacent to Site 1. Remediation goals for the former AS/SVE system that ran from 1998 through 2002 on-site did not consider possible soil vapor migration to the residential neighborhood east and adjacent to Site 1. Subsequent soil gas samples exceeded New York State Department of Health (NYSDOH) subslab criteria for TCE and PCE. The testing continued in 2009, and as a CERCLA removal action, air purification units and sub-slab depressurization systems were installed in six residential homes. In December 2009, an SVE Containment System was completed at the site boundary. By August 2010, the TCE and PCE concentrations in the off-NWIRP soil gas decreased by greater than 99 percent, and by November 2010, indoor air concentrations in all six homes were below NYSDOH Air Guideline Values (NYSDOH, 2006). Comparison of subslab soil vapor and indoor air results to NYSDOH decision matrices resulted in the determination of no further action (NFA) for all homes. The mitigation systems were removed in 2010 and the SVE Containment System is currently in operation at Site 1 (TtNUS, 2011).

In 2009, a response action was conducted that consisted of the demolition of four buildings (03-13, 03-38, 03-31, 03-33), seven concrete pads, the upper six feet of the sanitary settling tank adjacent to building 03-12, removal of a steel sheet wall, and the abandonment of 24 AS/SVE wells (ECOR Environmental, 2009).

In 2012, two underground storage tanks (USTs) associated with AOC 32 were uncovered during re-grading activities at Plant 3. A sample from one of the UST's contained concentrations of vinyl chloride at 19,000 µg/L, cis 1,2-dichloroethene at 22,000 µg/L, trichloroethene at 1,400 µg/L, and PCE at 1,300 µg/L. In September 2012, the contents of the two USTs were removed and disposed off site. The interior of the USTs were pressure washed to remove residual solid and liquid wastes and were transported off site to a recycling facility.

2.5 ENVIRONMENTAL INVESTIGATION HISTORY

An Initial Assessment Study (IAS) of NWIRP Bethpage conducted in 1986 identified three environmental sites, including Site 1, at NWIRP Bethpage that posed a threat to human health and the environment.

A Phase 1 Remedial Investigation (RI) was conducted in August, 1991 (HNUS, 1992) to determine the nature and extent of contamination identified during the IAS, and which portion of the contamination was related to Site 1. Contamination was not completely defined during the Phase 1 RI, so the Navy proceeded with a Phase 2 RI (HNUS, 1993). The Phase 2 RI further delineated the horizontal extent of PCB-contaminated soils, and the extent of VOC-, metal- and PAH-contaminated soils. The Phase 2 RI also identified the nature and extent of off-property groundwater contamination in the adjacent neighborhood. Based on the low mobility of PCBs, the vertical extent of PCB-contaminated soil was estimated to be limited to approximately 7 feet bgs and migration to groundwater was not anticipated.

An FS was conducted in 1994 to develop and evaluate remedial alternatives that could be implemented to address risks associated with Site 1 contamination. An analysis was conducted to estimate the risks to human health and/or the environment if the soil contamination at NWIRP Bethpage Site 1 was not remediated. Incremental lifetime cancer risks for current soil exposure were calculated to be approximately 2×10^{-4}, for the adult employee, dermal exposure scenario. PCBs and arsenic were the major drivers of potential risk (HNUS, 1994).

A Proposed Remedial Action Plan (PRAP) was prepared in October 1994, to summarize the contents of the RI and FS and to present to the public, the Navy and State's approved plan to remediate soils at Site 1. The preferred remedy described in PRAP would address remediation of metal-, VOC-, and PCB-contaminated soils and shallow groundwater at Site 1.

A ROD was signed for Site 1 in 1995 to address primarily contaminated soil. The major components of the remedy included excavation of PCB- and metal-contaminated soil, operation of an AS/SVE for VOCs in soil and shallow groundwater, and installation of a permeable cover (NAVFAC, 1995).

Post-ROD sampling conducted in 1995 and 1996 determined that the extent of PCB-contaminated soils was much greater than the original estimates. PCBs greater than 10 mg/kg in soil were found to depths below 32 feet bgs. Also, some soils contained elevated concentrations of cadmium. Subsequent soil investigations were conducted through 2012 to delineate the horizontal and vertical extents of PCB-contaminated soil, and which are further discussed below.

2.6 NATURE AND EXTENT OF CONTAMINATION

The discussion in this section is based primarily on soil, groundwater, soil vapor/indoor air, and lithologic investigations conducted from May 2009 to June 2013. In addition, information from sampling events prior to 2009 are used to support the development of the conceptual site model (CSM) and in particular the magnitude and extent of contamination. Because potential future uses of the site have not been established, soil data are compared to criteria ranging from unrestricted use to industrial use scenarios. Since groundwater is part of a sole source drinking water aquifer, associated data are compared to tap water risk screening levels, groundwater standards, and drinking water standards.

Surface Soil

Surface soil throughout Site 1 contains PCBs and PAHs at concentrations that exceed risk-based levels and NYSDEC Part 375 Soil Cleanup Objectives for Commercial Use (Table 2-1). The maximum detection of PCBs in surface soils is 3,800 mg/kg and the maximum individual PAH concentrations are 1.1 to 4.6 mg/kg. In addition, several metals including arsenic at 55.8 J mg/kg, cadmium at 74.9 mg/kg, and chromium at 69.5 mg/kg exceed NYSDEC or USEPA screening levels. Arsenic and cadmium exceed the NYSDEC Soil Cleanup Objectives at two locations each, all of which are co-located with PCB-contaminated soil.

The estimated aerial extent of PCB-contaminated surface soil (0 to 2 feet below ground surface, with PCBs greater than 1 mg/kg) is approximately 4.5 acres and totals 14,500 cubic yards (Table 2-2 and Figure 2-2). The surface soil contains a calculated 420 pounds of PCBs (Appendix A - Mass and Volume Calculations). Based on the presence of gravel or concrete, there is no surface soil at Dry Wells 20-08 or 34-07.

Subsurface Soil

Subsurface soil at this site contains PCBs, cadmium, and chromium at concentrations that exceed risk-based levels, NYSDEC Part 375 Soil Cleanup Objectives for Commercial Use, or NYSDEC Part 375 Soil Cleanup Objectives for Protection of Groundwater (Table 2-1). In addition, PCBs and chromium were detected in groundwater at concentrations greater than the potential remediation goals (MCLs), but cadmium was not.

The maximum detection of PCBs in unsaturated subsurface soils (2 to 50 feet bgs) is 3,500 mg/kg at 8 to 10 feet bgs; the maximum detection of cadmium is 3,260 mg/kg at 10 to 12 feet bgs; and the maximum detection of chromium is 1,000 mg/kg at 10 to 13 feet bgs. These locations and depths generally correspond to the bottoms of the cesspools. Chromium was sampled for total chromium, and only exceeds NYSDEC Part 375 Soil Cleanup Objectives for Commercial Use, assuming that it is present in the hexavalent form. Since, hexavalent chromium was used in plating operations at the site and was detected in site groundwater, some of the residual chromium in soil is likely in the hexavalent form.

Figures 2-3 to 2-7 present the isoconcentration contours for PCBs and identify the locations and depths where cadmium and chromium exceed the Soil Cleanup Objectives. The figures correspond to depth intervals of 2 to 10, 10 to 20, 20 to 30, 30 to 40, and 40 to 50 feet bgs, respectively. The PCBs are widespread throughout the area and in some locations are found throughout the soil column, whereas the maximum cadmium and chromium detections and frequency of detection are generally associated with the former leaching pools. Arsenic exceeds the Soil Cleanup Objectives at several locations at a maximum concentration of 150 mg/kg at 6 to 8 feet bgs. Also, SVOCs, VOCs, and metals were identified with the 1995 ROD and will be retained as COCs (see Table 2-1).

Saturated subsurface soils at this site contain detections of PCBs, and to a lesser extent, cadmium and chromium. The detections of PCBs exceed the Part 375 Soil Cleanup Objectives for the Protection of Groundwater, with the maximum detection of PCBs in saturated subsurface soils (50 to 65 feet bgs) of 310 mg/kg at 60 to 62 feet bgs. The maximum detection of cadmium is 8.2 mg/kg at 58 to 60 feet bgs and the maximum detection of chromium is 21 mg/kg at 50 to 52 feet bgs, both of which only slightly exceed NYSDEC Soil Cleanup Objectives. See Figures 2-8 to 2-9 for areas of contamination for the saturated soil in the 50 to 60 feet bgs and 60 to 70 feet bgs interval, respectively.

Subsurface soil volume and mass estimates are discussed based on location. For Site 1, the estimated aerial extent of PCB-contaminated subsurface soil (2 to 65 feet bgs) and the volume of contaminated soil vary based on the PCB concentration. Using the 1 mg/kg PCB concentration, the areal extent is approximately 3 acres and affects approximately 144,000 cubic yards of soil. Whereas, for the 50 mg/kg PCB concentration, the areal extent is approximately less than an acre and affects approximately 82,000 cubic yards of soil. There is an estimated 4,300 pounds of PCBs in the subsurface soil at Site 1. See Table 2-2 for additional detail.

For the two dry wells, the areal extent and volume of contaminated media are similar when using the 1, 10, 25, and 50 mg/kg PCB concentrations. The areal extent of soil contamination at Dry Well 20-08 is approximately 0.38 acre and affects approximately 12,800 cubic yards. There is approximately 2,500 pounds of PCBs, with contamination extending to approximately 60 feet bgs (Figures 2-5 to 2-8).

The areal extent of soil contamination at Dry Well 34-07 is approximately 0.02 acre, affects 1,200 cubic yards, and contains approximately 300 pounds of PCBs. The contamination extends to 50 feet bgs (Figures 2-10 to 2-12) (Appendix A - Mass and Volume Calculations and Figures).

Groundwater

Shallow (40 to 67 feet bgs), intermediate-depth (95 to 200 feet bgs), and deep groundwater (180 to 294 feet bgs) at this site contain detections of VOCs, PCBs, hexavalent chromium, total chromium, and arsenic (Table 2-3). The VOCs in groundwater are being addressed by the OU2 ROD and are not considered further in this FS. Detections of PCBs, hexavalent chromium, and total chromium exceeded Federal and NYSDOH MCLs and NYSDEC Groundwater Quality Standards. The maximum detection of total PCBs in shallow groundwater is 24 µg/L (TT-MW301S), the maximum detection of total PCBs in intermediate-depth groundwater is 6.9 µg/L (TT-MW303I1), and the maximum detection of PCBs in deep groundwater is 8.2 µg/L (TT-MW304D). The PCB MCL is 0.5 µg/L and the Groundwater Quality Standard is 0.09 µg/L. Isoconcentration contours for PCBs in the shallow, intermediate-depth, and deep groundwater are presented in Figures 2-13, 2-14, and 2-15, respectively. MCL exceedences extend from Site 1 to the south and southwest property line. Groundwater Quality Standard exceedences extend from the northern property line to the southern property line, suggesting that at least a portion of the PCBs originated from an upgradient source.

The maximum detections of hexavalent chromium in shallow groundwater is 158 µg/L (TT-AOC22-MW10), the maximum detection of hexavalent chromium in intermediate-depth groundwater is 200 µg/L (TT-MW304I2), and the maximum detection of hexavalent chromium in deep groundwater is 86 µg/L (TT-MW301D). The maximum detection of total chromium in shallow groundwater is 160 µg/L (TT-MW304I2), the maximum detection of total chromium in intermediate-depth groundwater is 182 µg/L (TT-MW304I2), and the maximum detection of total chromium in deep groundwater is 92 µg/L (TT-MW301D). Detections of hexavalent and total chromium in shallow and intermediate-depth groundwater exceeded Federal and NYSDOH MCLs. The chromium/ hexavalent chromium MCL is 100 µg/L and the NYSDEC Groundwater Quality Standard is 50 µg/L. Isoconcentration contours for hexavalent chromium in shallow, intermediate-depth, and deep groundwater are presented in Figures 2-16, 2-17, and 2-18, respectively. The chromium exceedances are present sporadically throughout the former NWIRP, with no apparent single source.

The maximum detection of arsenic in groundwater is 5.2 µg/L (TT-MW304I1). The arsenic concentrations do not exceed Federal or NYSDOH MCLs in groundwater, the likely Preliminary Remediation Goal; and therefore, other than as part of monitoring requirements for a groundwater remedy, arsenic will not be discussed further in the FS.

The estimated volume of PCB-contaminated groundwater above MCLs is approximately 550 million gallons, and extends south and southwest of Site 1 for at least 800 feet. Based on the concentration and volume, the groundwater contains approximately 4 pounds of soluble PCBs. The volume of contaminated groundwater and corresponding mass of hexavalent chromium above MCLs is estimated to be 6.4 million gallons and 7 soluble pounds.

Soil Vapor/Indoor Air

The Human Health Risk Assessment (HHRA) identified potential vapor intrusion issues with carbon tetrachloride, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, tetrachloroethene, 1,2,4-trichlorobenzene, and trichloroethene. Predicted indoor air concentrations and the associated calculated risk varied based on the attenuation factor used. If an attenuation factor of 0.1 is used, the calculated Incremental Lifetime Cancer Risk (ILCR) would be 3×10^{-4}; or if an attenuation factor of 0.03 is used, the calculated ILCR would be 1×10^{-4}. Industrial buildings are present west and south of Site 1. A residential neighborhood is located east of Site 1. A Soil Vapor Extraction containment system, operating as an interim measure, is used to control VOC migration into residential homes.

A summary of a recent sampling events and associated analytical data tables for site soil, groundwater, and indoor air samples can be found in the 2014 Remedial Investigation Addendum (Tetra Tech, 2015). The source of the VOCs is believed to be associated with soils located at variable depths throughout Site 1.

2.7 SUMMARY OF RISK

A current HHRA was prepared and submitted in the RI Addendum and is summarized below. The receptors evaluated were construction/excavation workers, commercial/industrial workers, adolescent trespassers, and potential child and adult on-property and off-property residents.

For the construction and industrial workers and trespasser exposure to soil and groundwater, under the reasonable maximum exposure (RME) scenario, risks were within the 10^{-4} to 10^{-6} ILCR range. Under the central tendency exposure (CTE) scenario, for the construction worker and trespasser, the risks were less than the 10^{-4} to 10^{-6} ILCR range, whereas for the industrial worker, the risks were within the 10^{-4} to 10^{-6} ILCR range. Primary contributors to these risks were exposure to Aroclor-1248 and -1254 in site soil. The hazard quotients (HQs) for these receptors and scenarios were 1 or less.

For the hypothetical future child, adult, and lifelong resident exposure to soil and groundwater, under the RME and CTE scenarios, risks exceeded the 10^{-4} to 10^{-6} ILCR range. Consumption of hexavalent chromium in groundwater was the primary contributor to risk. Excluding the hexavalent chromium in groundwater exposure, under the RME and CTE scenarios, the risks were within the 10^{-4} to 10^{-6} ILCR range. Exposure to Aroclor-1242, -1248 and -1254 in soil and groundwater and arsenic in groundwater resulted in risks within the 10^{-4} to 10^{-6} ILCR range. Except for hypothetical child resident (HQ equal to 8 [RME] and 2 [CTE]), exposure to Aroclor-1254 in soil, the HQs for these receptors and scenarios were less than one.

VOCs and SVOCs were detected in subsurface soils at Site 1, but did not present an unacceptable risk.

Without the operation of the SVE Containment System, the site specific HHRA identified potential risk (greater than 10^{-4} to 10^{-6} ILCR) for exposure to soil vapor based on the maximum concentrations predicted for indoor air (attenuation factor of 0.03 to 0.1) for 7 VOCs (carbon tetrachloride, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, tetrachloroethene, 1,2,4-trichlorobenzene, and trichloroethene). Also, based on the assumed attenuation factor, the HQs for tetrachloroethene and/or trichloroethene are greater than 1. Chemicals retained as COCs from the HHRA include PCBs for soil; PCBs and hexavalent chromium for groundwater; and VOCs for vapor intrusion.

Ecologically, Site 1 is located in a relatively flat area with little topographic relief except for a 4-foot high vegetated windrow along the eastern edge of the site. There are no surface water features located on or near the site. Due to the lack of both aquatic habitats and terrestrial vegetation, there are no sensitive ecological receptors capable of being significantly affected by either environmental contamination or remedial activities.

3.0 REMEDIAL ACTION OBJECTIVES

This section describes the initial steps to develop alternatives for the remediation of contaminated soil and groundwater at Site 1, including the presentation of Applicable or Relevant and Appropriate Requirements (ARARs) and the development of Remedial Action Objectives (RAOs).

3.1 NCP REQUIREMENTS

The NCP requires that the selected remedy meet the following objectives:

- Each remedial action selected shall be protective of human health and the environment.
- On-site remedial actions that are selected must attain those ARARs that are identified at the time of the ROD signature.
- Each remedial action selected shall be cost-effective, provided that it first satisfies the threshold criteria above. A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.
- Each remedial action shall use permanent solutions and alternative treatment technologies or resource-recovery technology to the maximum extent practicable.

The statutory scope of CERCLA as amended by Superfund Amendments and Reauthorization Act (SARA) includes the following general objectives for remedial actions at all CERCLA sites:

- Remedial actions "…shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment".
- Remedial actions "…in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants is a principal element" are preferred. If the treatment or recovery technologies selected are not a permanent solution, an explanation must be published.
- The least-favored remedial actions are those that include "off-site transport and disposal of hazardous substances or contaminated materials without treatment where practicable treatment technologies are available".
- For any hazardous substance, pollutant, or contaminant that will remain onsite, the selected remedy must attain ARARs as discussed below.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

As required by Section 121 of CERCLA, with respect to any hazardous substance, pollutant or contaminant that will remain on site, remedial actions carried out under Section 104 or secured under Section 106 by the President must attain the level of any standard, requirement, criteria, or limitation under any federal environmental law or any promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation unless a waiver is exercised pursuant to CERCLA Sec. 121 (d)(4). Only promulgated federal and State laws and regulations can be considered ARARs. If the ARARs are neither applicable nor relevant and appropriate, the federal lead agency has the discretion to also apply "to be considered" (TBC) criteria or guidelines. These distinctions are critical to understanding how the federal lead agency integrates environmental requirements from other federal and State laws into its cleanup decision. The definitions of ARARs and TBCs below are from the NCP (40 C.F.R. 300.5).

- Applicable requirements are those substantive cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
- Relevant and appropriate requirements are those substantive cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable," address problems or situations sufficiently similar (relevant) to those encountered at a CERCLA site, that their use is well-suited (appropriate) to the particular site.
- TBC information are non-promulgated, substantive criteria, advisories, guidance, and proposed standards that have been issued by the federal or state government that are not legally binding and do not have the status of potential ARARs. However, the TBC information may be useful for developing an interim remedial action or for determining the necessary level of cleanup for the protection of human health and/or the environment. Examples of TBC information include USEPA Drinking Water Health Advisories, Reference Doses, and Cancer Slope Factors.

In determining which response or remedial requirements must be met, the lead agency distinguishes between substantive and administrative requirements. CERCLA response actions must meet substantive requirements but not administrative requirements. Substantive requirements are those dealing directly with actions or with conditions in the environment. Administrative requirements implement the substantive requirements by prescribing procedures such as fees, permitting, and inspection that make substantive requirements effective. This distinction applies to onsite actions only.

Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs set health- and ecological-based concentration limits or discharge limits in various environmental media for specific hazardous substances, pollutants, or contaminants. Examples of chemical-specific ARARs for Site 1 are the New York Water Classifications and Quality Standards for groundwater and the New York State Soil Cleanup Objectives for soil. Examples of TBCs for Site 1 are USEPA Regional Screening Levels (RSLs) for both soil and groundwater and reference dosages and cancer slope factors used during the risk assessment and as a reference for selecting PRGs. Chemical-specific ARARs and TBCs for Site 1 are detailed in Table 3-1.

The primary chemical-specific ARARs for establishing groundwater cleanup levels at Site 1 are the federal drinking water MCLs (USEPA National Primary Drinking Water Regulations [USEPA MCLs]) and those

New York Department of Health (NYDOH) Public Water Supply Regulations (NYSDOH MCLs) that are more stringent that the USEPA MCLs. The primary chemical-specific ARARs for establishing soil cleanup levels at Site 1 are the NYSDEC Soil Cleanup Objectives for Commercial Use and for the Protection of Groundwater.

Location-Specific ARARs and TBCs

Location-specific ARARs and TBCs are design requirements or activity restrictions that are based on the geographical position of a site. Location-specific ARARs for Site 1 are presented in Table 3-2. A primary location-specific ARAR applicable to any remedial alternative at Site 1 is the water classification for site groundwater as class GA, affecting chemical-specific ARARs for drinking water standards.

Action-Specific ARARs and TBCs

Action-specific ARARs set performance, design, or other standards for particular activities in managing hazardous substances, pollutants, and contaminants. Potential action-specific ARARs for Site 1 are identified in Table 3-3. Action-specific ARARs vary based on the type of COC and technology used. An example of an action-specific ARAR is the state specific requirement for managing investigative derived wastes (IDW).

3.3 REMEDIAL ACTION OBJECTIVES

The RAOs are statements that define the extent to which sites require cleanup to protect human health and the environment and comply with ARARs. The RAOs reflect the COCs, exposure routes and receptors, and acceptable chemical concentrations (or range of acceptable chemical concentrations) for soils and groundwater at Site 1. Contaminated soils, soil vapor, and groundwater represent a potential threat to human health. The RAOs for Site 1 are as follows:

- Prevent human exposures (ingestion, dermal contact, and dust inhalation) to soil contaminated at concentrations greater than PRGs.
- Prevent leaching of COCs from soil to groundwater that would impact groundwater in excess of PRGs.
- Prevent human exposures (inhalation and ingestion) to groundwater contaminated at concentrations greater than PRGs.
- Prevent human exposures to soil vapors contaminated at concentrations greater than PRGs.
- Prevent offsite migration of contaminated soil via erosion to surface water and sediment in recharge basins.

3.4 PERFORMANCE CRITERIA

CERCLA preliminary remediation goals are the same as performance criteria established under RCRA to evaluate remedial alternatives, and are used as guidelines in the conceptual design and cost estimates for remedial alternatives. Performance criteria provide a basis for further delineating the extent and volume of impacted media that require remediation and provide the design performance of the remedial alternatives. The performance criteria described here represent the levels of performance necessary to meet the RAOs. They also provide benchmarks for achieving compliance with ARARs. A monitoring program capable of demonstrating conformance with the performance criteria would be an element of each remedial alternative.

Soils

As identified in Table 2-1, the COCs for soils consist of metals, chlordane, SVOCs, VOCs, and PCBs that represent a potential direct contact risk to human health and/or can leach and adversely impact groundwater quality. The selected PRGs are presented in Table 3-4 and consider NYSDEC Soil Cleanup Objectives for Commercial Use and for the Protection of Groundwater, in addition to USEPA MCLs and former 1995-ROD PRGs. Because of the limited availability of open space in the area for growth of industrial and commercial activities, construction activities may extend below depths typically considered in risk assessments; therefore, the PRGs would apply to deeper soils than normal. Note that the 1995 ROD PRGs were based on Technical and Administrative Guidance Memorandum (TAGM) 4046 values, which have since been replaced by NYSDEC Soil Cleanup Objectives.

Groundwater

As identified in Table 2-3, the COCs for groundwater are limited to arsenic, hexavalent chromium, total chromium, and PCBs. The selected PRGs are presented in Table 3-5 and consider USEPA MCLs, USEPA National Recommended Water Quality Criteria, NYSDOH MCLs, and NYSDEC Groundwater Quality Standards. The performance criteria for groundwater will be NYSDOH MCLs, as shown in Table 3-5. Alternative strategies that allow some level of contamination to remain at the site, but achieve the RAOs through long term groundwater use restrictions, will also be developed.

Vapor Intrusion

Residual VOCs are suspected to be present in soils and cesspools at the site. The 2014 Human Health Risk Assessment identified vapor intrusion potential with carbon tetrachloride, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, tetrachloroethene, 1,2,4-trichlorobenzene, and trichloroethene as COCs. In the absence of the ongoing operation of the SVE Containment System on NWIRP, the calculated concentrations of COCs in the indoor air for off-property residences and potential future on-property buildings resulted in a maximum ILCR of 3×10^{-4}. For the FS Addendum, trichloroethene and tetrachloroethene were identified as the primary risk drivers that need to be addressed. The performance criteria for soil vapor will be based on USEPA carcinogenic values, as shown in Table 3-6. Presented are values for both indoor air and soil vapors in close proximity to the residential housing. A residential neighborhood is east of Site 1 and commercial/industrial buildings are west and south of Site 1. An SVE Containment System is currently in operation as a removal action to control vapor migration to the east toward the residential neighborhood and a separate vapor extraction system is operating to control vapors under Plant 3. Treatment of these media and continued containment of vapors will be addressed with the remedial alternatives.

3.5 PRELIMINARY REMEDIATION GOAL (PRG) ATTAINMENT AREA

Current site conditions are summarized in Section 2.6. This section narrows the description of contamination to those media and areas that will be addressed by the remedial alternatives to achieve RAOs and comply with ARARs. The Attainment Area is defined as the area over which RAOs and associated PRGs, are to be met for soils, groundwater, and soil vapor.

The Attainment Area for soils is the area greater than PRGs, (1 to 50 mg/kg for PCBs, which generally coincides with detections of metals, SVOCs, and pesticides) to a depth of 65 feet bgs, including the areas for Dry Wells 20-08 and 34-07 which were included with Site 1 due to proximity and similarity in COCs.

The Attainment Area for groundwater is the area with concentrations of metals and PCBs greater than NYSDOH MCLs. The area of contaminated groundwater extends beyond Site 1 at least 800 feet to the south, and applies to depths ranging from 40 to 294 feet bgs.

The Attainment Area for VOCs in soil vapor is in unsaturated soil around the perimeter of Site 1, and in particular in the area of the eastern fence line. Unsaturated soil extends from the ground surface to the water table at a depth of approximately 50 feet bgs.

4.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section provides the identification of general response actions (GRAs) and the initial identification and screening of potential remedial technologies.

4.1 GENERAL RESPONSE ACTIONS (GRAs)

The GRAs describe a broad range of actions that will satisfy the RAOs at the site. The GRAs for soils include no action, institutional controls, containment (i.e. soil cap), removal and disposal of contaminated soils, ex-situ treatment, in-situ treatment, or a combination of these GRAs. The GRAs for groundwater include no action, institutional controls, and ex-situ treatment. The GRAs for soil vapor include no action, institutional controls, and in-situ and ex-situ treatment. Consideration of the No Action GRA is retained as a baseline for comparison of alternatives, and is also a requirement of CERCLA. The objective of this phase of the FS Addendum is to develop an appropriate range of remedial technologies and process options that will be used to develop the preliminary remedial alternatives. Remedial alternatives will be composed using individual general response actions or in combination to meet the RAOs. Soils and groundwater are the primary media of concern at Site 1, including possible leaching of contamination to groundwater, vapor intrusion due to VOCs in soil, and potential migration of surface soils off site due to runoff concerns (related to the storm water systems on-site).

The following GRAs will be evaluated:

- No Action
- Institutional Controls
- Containment
- Removal
- Disposal/Reuse/Discharge
- Ex-Situ Treatment
- In-Situ Treatment

The technology screening evaluation is performed in this section, with representative process options selected for each GRA. The selection of technologies and process options for initial screening is based on the “Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA” (USEPA, 1988). A preliminary screening is conducted to focus on relevant technologies and process options to treat the COCs in the relevant media of the site. Table 4-1 lists the GRAs for site media and identifies the approach that the GRA uses to achieve the RAOs.

4.2 DETAILED SCREENING OF SOIL TECHNOLOGIES AND PROCESS OPTIONS

Representative process options are selected based on a screening of effectiveness, implementability, and cost of a given technology. The following are descriptions of alternatives that will be considered, along with the evaluation criteria:

- Effectiveness
  - Protection of human health and the environment; reduction in toxicity, mobility, or volume; and permanence of the solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated medium.
  - Ability of the technology to attain the PRGs required to meet the RAOs.
  - Technical reliability (innovative versus well-proven) with respect to COCs and site conditions.
- Implementability
  - Overall technical feasibility at the site.
  - Availability of vendors, storage and disposal services, etc.
  - Administrative feasibility.
  - Special long-term maintenance and operation requirements.
- Cost (Qualitative)
  - Capital cost.
  - Operation and Maintenance (O&M) costs.

Table 4-2 identifies potentially applicable technologies and process options for addressing soil, groundwater, and vapor intrusion at Site 1. Table 4-2 also presents a preliminary screening of technologies to eliminate those that are clearly not viable for this site, or do not provide benefits over more basic technologies. Several technologies were excluded from further consideration because of impracticability, site conditions, or COC characteristics. The technologies that were retained are described below.

4.2.1 No Action

The No Action technology is considered for soil, groundwater, and soil vapor. No Action consists of maintaining the status quo at the site. As required under CERCLA regulations, the No Action alternative is carried through this FS Addendum to provide a baseline for comparison of alternatives and their effectiveness in mitigating risks posed by site COCs. No remedial actions are taken under this alternative, and there are no costs associated with this alternative. The existing SVE Containment System is in operation at Site 1 as interim action to prevent the migration of vapors off site. Under No Action, there would be no provision for continuing monitoring and operation and maintenance activities in association with these treatment systems.

Effectiveness

The No Action technology would not be effective in meeting the PRGs. Soil and groundwater COCs remain at concentrations that exceed risk-based values, New York State Commercial Soil Cleanup Objectives and NYSDOH MCLs. There would be no restrictions to prevent exposure to contaminated soil or groundwater, or exposure to contaminated soil vapors. In addition, contaminated soil could be removed from the site during construction activities and reused elsewhere. Leaching of soil contamination to groundwater would continue. PCBs degrade slowly and would remain present in soil for an extended period of time. The NG ONCT groundwater treatment system remains in operation. The system addresses VOCs in groundwater, and is not designed to address PCBs or metals. Surface soils can currently migrate via runoff into the storm water system (recharge basins) associated with Plant 3.

Implementability

The No Action technology would be easy to implement. Operation and maintenance activities associated with interim remedial actions, such as the SVE Containment System, would not be continued.

Cost

There are no costs associated with No Action.

Conclusion

No Action is retained to provide a baseline comparison.

4.2.2 Institutional Controls

<u>Land Use Controls (LUCs) and Fencing</u>

LUCs and fencing are considered for soil and groundwater. Administrative restrictions would be included through deed notifications to restrict the installation or use of public water supply wells, construction activities, or other actions to limit groundwater or soil use. Deed restrictions may remain in place while contamination remains. Fencing is used to further restrict access to the site, and in particular, contaminated surface soil.

Effectiveness

Prohibiting future use of contaminated site soil and groundwater, and installing and maintaining fencing, would reduce the occurrence of direct exposure to human receptors. Deed notifications would reduce the potential risk to human health by limiting ingestion of contaminated groundwater or contact with contaminated surface and subsurface soil. LUCs would restrict potable use of groundwater, but would not address the current migration of groundwater beyond the site or provide treatment for contaminated groundwater. LUCs would restrict use of site soil for construction activities (removal of soil to be used as top soil at other sites). The potential for vapor intrusion issues could be addressed in deed notifications, but would not prevent the migration of contaminated vapors to adjacent residential areas. Contaminated surface soil could continue to migrate off site via runoff.

Implementability

LUCs and fencing would be readily implementable. As part of a change of property to private ownership, provisions would be incorporated in property transfer documents to ensure that LUCs remain in place. Resources are readily available for administrative restrictions. Future planned site use is commercial.

Cost

Cost of LUCs would be low.

Conclusion

Deed restrictions will remain in place while contamination remains. Since the COCs degrade slowly, these restrictions could be for required for an extended period of time. Fencing will be maintained while contaminated surface soil is present. LUCs will likely be combined with other remedial technologies.

Monitoring/ Sampling/ and Natural Attenuation

Monitoring is considered for soil, groundwater, and soil vapor. Sampling and analysis of groundwater would be used to evaluate the effectiveness of treatment or natural attenuation mechanisms in reducing COC concentrations. It would also be used to determine if COC migration is occurring from the soil to the groundwater, if site soils are migrating via overland flow, or whether contaminated groundwater is migrating off property.

Effectiveness

Monitoring alone would not be effective in achieving any of the PRGs, but would be used to support implementation of other technologies. In particular, it would be used to identify areas that require action, or when response activities can be ended. Monitoring would be very effective in evaluating the presence and change in COC concentrations over time.

Implementability

A sampling and analysis program could be readily implemented. Sampling associated with the interim remedial actions (SVE, NG ONCT treatment systems) is currently being conducted.

Cost

Capital and O&M costs would be low to moderate, depending on the period of monitoring.

Conclusion

Monitoring is retained in combination with other process options for the development of remedial alternatives to determine if natural attenuation is occurring and/or the effectiveness of other process options that provide treatment.

4.2.3 Containment

Permeable Cover

A permeable cover is considered for soil. A permeable cover would involve the use of materials to prevent either direct contact or exposure to fugitive dusts associated with contaminated surface soil, while allowing precipitation infiltration and vapor migration. Cover material could consist of gravel or soil covered with vegetation.

Effectiveness

A permeable cover is a reliable technology that can be used to prevent direct exposure to contaminated soil and control erosion of contaminated surface soil. A permeable cover would not address leaching of COCs to groundwater. A permeable cover would not address groundwater or vapor intrusion.

Implementability

A permeable cover could be easily implemented. Materials and services required to implement this technology are readily available. A cover would limit future site use. Some landscaping/earthwork may be required to achieve slopes and proper grading for surface water runoff control. Deed restrictions may be required in conjunction with the use of a cover to limit future usage and to prevent damage of the covered areas. No off-site activities would occur.

Cost

The capital costs for a permeable cover would be low to moderate considering the area of cover required. O&M costs are moderate for permeable covers.

Conclusion

Although a permeable cover would achieve some of the RAOs, if would not address COC leaching to groundwater. Because capping is a component of the current OU1 ROD remedy, a permeable cover will be considered further.

Capping

A cap is considered for soil. Capping involves the installation of impermeable barriers over contaminated soils to restrict access and reduce infiltration of precipitation to prevent the vertical migration of soil contamination to groundwater. Consolidation and/or regrading of isolated quantities of contaminated soils prior to capping may be required. Cap materials can be either natural or synthetic. Frequently used materials include low-permeability clays such as bentonite, cement, asphalt, or synthetic membranes such as high-density polyethylene (HDPE) and polyvinyl chloride (PVC), or a combination of these materials. These materials can be covered with other materials (i.e. soil) to protect against weathering and erosion.

Effectiveness

Capping is a reliable technology that can be used to prevent exposure to contamination and the infiltration of precipitation. A cap would also restrict the mobility of surface soils, so off-site migration of surface soils would be prevented. A cap would not restrict horizontal COC migration from impacted saturated soil. The cap would reduce attenuation of VOCs and allow them to concentrate in soil vapor.

Implementability

A cap would be moderately difficult to implement. Materials and services required to implement this technology are available. A cap would limit future site use. Some landscaping/earthwork would be required to achieve slopes and proper grading for surface water runoff control. In addition, consolidation of waste materials to limit the extent of the cap and some excavation and offsite disposal of contaminated media at a properly permitted facility may be considered to reduce the height of the area. The site is relatively flat except for a 4 foot vegetated windrow on the eastern end, and a mounded area that partially buries the existing sanitary settling tank; however elevations do range across the site. The elevation at Site 1 ranges from 130 feet msl to the north and 122 feet msl to the south.

Cost

The capital costs for a cap would be moderate based on the size of the cap required and the need for multiple materials for a RCRA cap. A sizeable area at Site 1 would require capping (approximately 4.5 acres). O&M costs are low for caps.

Conclusion

A cap would reduce the migration of COCs to groundwater, as well as prevent direct contact risks, thereby meeting RAOs for soils in the short term. A cap could be combined with other GRAs (e.g. LUCs) to better meet RAOs associated with migration and ingestion of contaminated groundwater and mitigate exposure to contaminated vapors, and prevent damage to the cap.

<u>Vertical Barriers</u>

Vertical barriers would be used to control soil vapor and groundwater migration. Vertical barriers are made of impermeable or semi-permeable materials to prevent or minimize passage of fluids through barrier walls. Walls can be made of a slurry mixture (i.e. bentonite and water), or other low-permeable materials including cement, geomembranes, and steel sheet piling. Vertical barriers can be combined with low-permeability caps to prevent further infiltration of precipitation. The barrier would extend below the depth of contamination (beyond 65 feet bgs) and is normally extended downward to a low-permeability layer (i.e. clay) to prevent seepage of COC beneath the walls.

Effectiveness

Vertical barriers can be effective at reducing or eliminating horizontal migration of contaminated groundwater and/or vapors. This technology would be combined with monitoring to ensure the integrity of barrier walls. The absence of a continuous low-permeability layer (clay) beneath Site 1 would reduce the effectiveness of the vertical barriers and require the use of alternative mechanisms to control underflow.

Implementability

Vertical barriers would be implementable. The anticipated depth of the barrier (e.g., 90 feet) is feasible for some of the installation techniques. Utilities may need to be relocated if they are in the path of barrier walls. Laterally thin clay lenses are present throughout the site, but are discontinuous. Materials used to construct walls would need to be compatible with site COCs.

Cost

Costs associated with this technology are moderate, due to the depth of contamination.

Conclusion

Vertical barriers are retained in combination with other actions to control horizontal migration of contaminated groundwater and soil vapor.

4.2.4 Removal

<u>Groundwater /Soil Vapor Extraction System</u>

Groundwater and soil vapor extraction systems would be used to manage COC mass and concentrations in groundwater and soil vapor through active treatment. For Site 1, the existing soil vapor extraction (SVE) Containment System located along the eastern edge of Site 1 and the groundwater NG ONCT system located south of Site 1 would continue to operate. The SVE Containment System uses 12 wells and extracts a total of 300 to 400 cubic feet per minute of soil vapors. The system establishes a vacuum barriers at the eastern edge of Site 1 that also extends under the residential housing to the east. The groundwater ONCT system uses 5 wells and extracts a total of approximately 5 to 6 million gallons per day of water. Supplemental SVE wells installed in the middle of Site 1 may be considered to accelerate cleanup of the site.

Effectiveness

The SVE Containment System has been demonstrated to be effective at preventing vapor intrusion into the adjacent neighborhood. The use of supplemental SVE wells near residual source material in the middle of the site would be expected to decrease the time that the SVE Containment System needs to operate. NG has reported that the ONCT is effectively preventing the offsite migration of VOC-impacted groundwater from the NWIRP.

Implementability

The SVE Containment System and the ONCT are currently operating, and therefore there are no implementation issues. Installation of additional soil vapor extraction wells near the source of the contamination would be easy to install and operate.

Cost

Since the extraction systems are currently operating, additional costs would be low to moderate.

Conclusion

Retain continued operation of the SVE Containment System and ONCT system, and the installation and operation of a supplemental SVE wells for further consideration.

Bulk Excavation

Bulk excavation is considered for removing the soil. Removal of soils via bulk excavation involves the use of mechanical (construction) equipment. Traditional excavation equipment such as backhoes and bulldozers are typically used. Specialized equipment and procedures would be required for deeper excavations. Excavated material is loaded onto trucks and hauled off site to an approved disposal or treatment facility and/or could be treated and relocated on site. The logistics of the excavation must take into account the available space for operating equipment, loading and unloading to transport removed material, the location of the site, etc. Factors that affect the excavation design include the type of material to be removed, the load-bearing capacity of the ground surrounding the removal area, the depth and areal extent of the removal, and the elevation of the groundwater table. Removal of contaminated soil near buildings or roadways may require shoring of the walls (sheet piling) or scaling to get to the needed depth bgs. Site 1 is located in a highly commercialized area which limits horizontal development. Backfilling would require the use of clean fill from another area and/or the use of decontaminated soil. Dust control practices such as misting is typically conducted to control fugitive emissions.

Effectiveness

Excavation is a well-proven and effective method of removing contaminated soil from a site. Properly designed excavations would remove all or most of the highly contaminated soil.

Removal and disposal of soils would allow chemical-specific ARARs to be met for soils in the short term, reducing the continued leaching of soil contamination to groundwater. Permanent removal and replacement of the surface soil would stop off-site migration of contaminated soils. This technology could be combined with other GRAs to help meet RAOs.

Implementability

Contaminated soils found at the site would be amenable to excavation; however, implementation would be complicated due to the extensive depth of contaminated soils (up to 65 feet bgs), and because contaminated soils can be found beneath the water table (50 feet bgs). The areal extent of soil contamination is relatively large (approximately 4.5 acres), with contamination extending near Plant 3. Because the depth of contamination is approximately 65 feet bgs, extensive shoring would be required to stabilize excavation sidewalls if contaminated soils are removed to this depth. Specialized equipment may be required to achieve excavation to required depths.

Cost

The cost of excavation would be very high due to excavation of soils below the water table and requirement of shoring structures.

Conclusion

Although the costs and technical issues for a complete excavation would be significant, partial or complete excavation is retained for the development of remedial alternatives to achieve the RAO of limiting migration of soil contamination to groundwater or direct contact to soil.

4.2.5 Disposal/Beneficial Reuse/Discharge

Disposal/Beneficial Reuse

Disposal/beneficial reuse, as wells as consolidation, recycling, and salvage are considered for soil. Based on the presence of contamination, excavated soils will be disposed off-site, used as backfill in the excavation, consolidated, or recycled/salvaged. Off-site landfilling consists of transporting the excavated soil to an off-site treatment, storage, and disposal (TSD) facility. Off-site treatment in accordance with Land Disposal Restrictions may be required prior to disposal in a facility. Since New York State classifies PCBs with concentrations greater than 50 mg/kg as hazardous waste, some of the contaminated soils would require disposal under the hazardous waste regulations. Some of the material, and in particular concrete and steel at the site may be sent to a recycling facility.

Effectiveness

This technology is an effective disposal or reuse option for contaminated soil. Off-site landfills are permitted because they meet specific design and operation requirements, which ensures the effectiveness of these facilities. Clean soils may be used as backfill, but would be sampled prior to being used as fill material to ensure that residual contamination does not remain or perpetuate continuing risks to receptors. Removal and disposal of soils would allow chemical-specific ARARs to be met for soils in the short term and reduce the continued leaching of soil contamination to groundwater. Permanent removal of soils would stop off-site migration of contaminated soils. The use of recycling and salvage would reduce the amount of wastes to be disposed in a landfill.

Implementability

Landfilling, consolidation, recycling, or reuse would be implementable. Local facilities and services are readily available for non-hazardous soils. Hazardous waste landfills are not present locally, are less common, and are more expensive to use. Disposal in a landfill would require the removal of free liquids. A waste profile would have to be prepared, which includes COC concentrations and their leachability characteristics. If soils are used as backfill, they would need to be tested prior to their use to ensure COCs do not remain. Because of lack of space, on-site landfilling is not implementable for this site.

Cost

Cost of landfilling would be high due to hazardous waste requirements, transportation costs, and the volume of contaminated soil present. Disposal in hazardous waste landfills (RCRA Subtitle C) or Toxic Substance

Control Act (TSCA) landfills is more expensive than disposal in RCRA Subtitle D landfills. If soils can be used as backfill and/or treated, this may reduce costs.

Conclusion

Landfilling, consolidation, recycling/salvaging, and reuse are retained in combination with the excavation process option for the development of remedial alternatives.

Discharge

Discharge is the release of gases or water back into the environment. Monitoring is used to identify the quality of fluids. Based on a comparison of this quality with regulations and health studies, the need for treatment can be determined. The SVE Containment System currently uses vapor phase granular activated carbon (GAC) treatment and the off gas is discharged to the atmosphere at Site 4, near the center of the former NWIRP. The ONCT system uses air stripping for VOC treatment, and discharges the water to recharge basins or reuses the water.

Effectiveness

Discharge is an effective means of discharging soil gas and water that has been collected and treated.

Implementability

The discharge systems are currently present and there are no implementation concerns.

Cost

Costs are low.

Conclusion

Discharge will be retained as an option for discharging extracted soil vapors and water. Treatment will be used as needed to comply with discharge standards and be protective of human health.

4.2.6 Ex-situ Treatment

Granular Activated Carbon

Granular activated carbon (GAC) is a permeable medium through which a fluid is passed to remove impurities. The GAC has a high surface area that allows organics to adsorb onto its surface. GAC is used for both water-and air-based fluids. After the organics saturate the medium, it is disposed or recycled off site.

Effectiveness

GAC has been demonstrated to be very effective at removing VOCs from air steams and PCBs from water streams. Monitoring of the off gases and at in bed locations are performed to determine when COCs may break through.

Implementability

GAC is implementable with several vendors available to provide treatment units and recycle/disposal services.

Cost

The cost is moderate.

Conclusion

Retain liquid phase GAC for addressing PCBs in groundwater and vapor phase GAC for addressing VOCs in off gas in accordance with requirements.

<u>Ion Exchange</u>

Ion Exchange is a permeable medium through which a fluid is passed to remove impurities. Depending on the inorganic to be removed, cation and anion resins are used. The ion exchange resin has a high surface area that allows inorganics to adsorb onto its surface. Ion exchange is used for water streams. After the inorganics saturate the medium, it is disposed or recycled off site.

Effectiveness

Ion exchange has been demonstrated to be very effective at removing inorganics from water streams. Monitoring is conducted to determine when COCs may break through.

Implementability

Ion exchange is implementable with several vendors available to provide treatment units and recycle/disposal services.

Cost

The cost is moderate to high.

Conclusion

Retain ion exchange for addressing metals in groundwater in accordance with requirements.

4.2.7 In-situ Treatment

<u>Physical/Chemical – Solvent Extraction</u>

Solvent extraction is considered for soil. Solvent extraction involves the injection of a solvent into the subsurface soil using an injection and infiltration process to remove organic COCs. Extraction fluids must then be recovered from the underlying aquifer or destroyed in-situ (via biodegradation).

Effectiveness

Solvent extraction can be used to treat SVOCs and PCBs. Solvent extraction was demonstrated to be potentially effective at removing PCBs from Site 1 soil during bench scale testing using VertecBio Gold #4. PCB concentrations were reduced from 270 mg/kg to an average concentration of approximately 6.4 mg/kg. Concentrations of PCBs at Site 1 range from less than 1 mg/kg to 3,800 mg/kg, and up to 45,000 mg/kg at Dry Well 20-08. Treatment of the higher concentration wastes may require additional extraction steps.

Implementability

This technology would be considered innovative. While vendors are available, vendors may not be able to supply required quantities of solvent. During bench scale tests, clean solvent was used during each extraction. Recycling solvent would reduce the required volume. In addition, the regulatory acceptance of injecting a solvent, even one considered to be environmentally friendly, is uncertain.

Cost

Costs are moderate to high depending on the size of the injection well network, amount of solvent required, and the extent that additional treatment of extraction fluids is needed (air sparging to enhance biodegradation would likely be required).

Conclusion

Solvent extraction is retained as an innovative technology to be combined with other process options for the development of remedial alternatives.

<u>Physical – Solidification/Stabilization</u>

Solidification/stabilization is considered for in-situ treatment of soil. Solidification/stabilization is the process through which soil is mixed with a slurry (e.g. bentonite, and/or other materials) in a defined volume to contain COCs within a hardened form. Other materials, or reagents, can be combined with slurry mixtures to provide treatment while COCs are solidified in columns. Depending on the depth of contamination, two types of mixing can be used: in-situ soil mixing, and jet mixing. This technology can be used to completely encapsulate the contaminated media.

Effectiveness

The in-situ soil mixing and jet mixing technologies are well demonstrated. The soil mixing technology is limited by depth and may not be able to effectively access the deeper soil at the site. The jet mixing technology would not be limited by depth. The cured mixture can be readily tested to verify the integrity of the structure. This technology would also be applicable to other soil COCs like SVOCs, VOCs, and metals.

Implementability

Vendors are available for both technologies; however, applications for in-situ soil mixing are limited to depths of approximately 50 feet bgs, where jet mixing can be applied to depths up to and exceeding 100 feet bgs (contamination at this site extends to depths of 65 feet bgs). In-situ soil mixing and jet mixing both use boreholes to advance the slurry mixture to depth, but the borehole must remain continuously open during jet mixing. Utilities are generally relocated prior to solidification. The radius of influence for jet mixing is often larger than that for soil mixing, allowing for more accurate angling beneath the ground surface (in proximity of utilities). For jet mixing, some bore holes may need to be pre-drilled to advance auger rods to the depths required. Both techniques increase subsurface soil volumes, and may impact future site use.

Cost

Costs associated with this technology are high considering the depth of contamination and the potential to relocate utilities.

Conclusion

Solidification is being retained as a process option to be combined with monitoring to address deep subsurface soil contamination to prevent the continued leaching of COCs to groundwater.

4.3 SELECTION OF REPRESENTATIVE PROCESS OPTIONS

Table 4-3 presents a summary of the retained remedial technologies that will be developed into alternatives in Section 5.0. As noted previously, this FS Addendum will focus on soil treatment, with both active and contingent treatment of groundwater and soil vapors. COC reduction in groundwater is expected to occur through natural attenuation after treatment of source soil COCs, and monitoring will be an associated component with action alternatives to determine their effectiveness.

5.0 DEVELOPMENT AND EVALUATION OF REMEDIAL ALTERNATIVES

This section presents the development, description, and evaluation of remedial alternatives for management or treatment of COCs in soil, soil vapor, and groundwater at Site 1 under CERCLA methodology. The remedial alternatives are developed by assembling technologies and representative process options after the initial screening process (Section 4.0). During the remedy selection process, other individual components can be selected as part of the final remedy. Table 5-1 provides additional details on the analysis factors and considerations of each alternative.

5.1 EVALUATION CRITERIA

Under CERCLA guidance, the remedial alternatives are evaluated according to their ability to meet the following threshold criteria, primary balancing criteria, and modifying criteria:

<u>Threshold Criteria 1 – Overall Protection of Human Health and the Environment</u>

This standard provides a discussion on how the alternative reduces risk to human health through COC exposure, reduces the threat to additional environmental media, and reduces the risk to ecological receptors. This standard is used to evaluate how risks would be eliminated, reduced, or controlled through treatment, engineering, institutional controls, or other remedial activities.

<u>Threshold Criteria 2 – Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)</u>

This standard verifies that the alternative meets chemical-, action-, and location-specific ARARs.

<u>Primary Balancing Criteria 1 – Long-term Effectiveness and Permanence</u>

This criterion discusses the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing the remedial action. The primary components of this criterion are the magnitude of residual risk remaining at the site after remedial objectives have been met, and the extent and effectiveness of controls that might be required to manage the risk posed by treatment residuals and/or untreated wastes. This criterion also addresses how failure of a technology would immediately impact receptors.

<u>Primary Balancing Criteria 2 – Reductions of Toxicity, Mobility, and Volume through Treatment</u>

This criterion discusses the treatment process involved with the alternative and the anticipated performance of the alternative’s treatment technologies in permanently and significantly reducing toxicity, mobility, and/or volume of hazardous materials at the site. This criterion addresses the quantity of hazardous material treated or removed from the site, the scope of the action taken to mitigate risks, risks associated with treatment, and risks associated with remaining residuals.

<u>Primary Balancing Criteria 3 – Short-term Effectiveness</u>

This criterion considers the effect of each alternative on the protection of human health and the environment during remedial action construction and implementation.

Primary Balancing Criteria 4 – Implementability

This criterion discusses the technical and administrative feasibility (i.e., the ease or difficulty) of constructing, operating, and maintaining a remedial action alternative, and the availability of required services and materials during implementation.

Primary Balancing Criteria 5 – Cost

This criterion evaluates both capital and operation and maintenance costs of implementing each alternative. The cost of an alternative encompasses all engineering, construction, and long-term future (e.g., O&M) costs incurred over the life of the project. The cost of each alternative is not intended to be a final project cost, but is developed with an expected accuracy range of minus 30 to plus 50 percent (USEPA, 1988).

Cost estimates are based on similar project experience, industry knowledge, and cost estimating references, as well as information provided by vendors, subcontractors, and regulators. The costs of the remedial alternatives are compared using the estimated present value (PV) of the capital and long-term costs (O&M) in current year (2015) dollars. The PV allows costs for remedial alternatives to be compared by discounting all costs to the year that the alternative is implemented.

Modifying Criteria – State and Community Acceptance

This modifying criterion addresses the acceptability of the remedial alternatives to the State and the community. As with regulatory acceptance, community concerns will be used to evaluate each remedy in this FS. Consistent with CERCLA and the NCP, public comments will be solicited on the selected alternative presented in the Proposed Plan and addressed in the Record of Decision (ROD), and will be considered in the selection of a remedy. Regulatory agencies (e.g., USEPA and NYSDEC) will review this FS and provide comments and input as appropriate.

The remedial alternatives developed and discussed in the following sections include both soil (S-), groundwater (G-), and soil vapor (SV-) alternatives:

- Alternative S-1: No Action
- Alternative S-2: Permeable Cover, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), and Land Use Controls
- Alternative S-3: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), and Land Use Controls
- Alternative S-4: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, and Land Use Controls
- Alternative S-5A: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solidification of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls
- Alternative S-5B: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, In-situ Solvent Extraction of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls

- Alternative S-6: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), Soil Cover, and Land Use Controls
- Alternative S-7: Excavation and Offsite Disposal of PCB-contaminated soil (Greater than 1 mg/kg)
- Alternative SV-1: No Action
- Alternative SV-2: Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System
- Alternative SV-3: Soil Vapor Monitoring, Land Use Controls, Continued Operation of the SVE Containment System, and Enhanced Soil Vapor Extraction at Site 1.
- Alternative G-1: No Action
- Alternative G-2: Monitoring and Land Use Controls
- Alternative G-3A: Monitoring, Land Use Controls, and Upgrade of the ONCT System with GAC Treatment
- Alternative G-3B: Monitoring, Land Use Controls, and Upgrade of the ONCT System with Ion Exchange Treatment

5.2 DEVELOPMENT AND EVALUATION OF REMEDIAL ALTERNATIVES FOR SOILS AND GROUNDWATER

5.2.1 Alternatives S-1, SV-1, and G-1: No Action

Development

The no action alternative is required under CERCLA to be evaluated as a baseline for other alternatives. The no action alternative does not include institutional controls or remedial activities to identify or minimize risk to public health or the environment. Additionally, the no action alternative does not include a monitoring program or five-year reviews. Under this alternative, the existing SVE Containment System would no longer operate.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternatives S-1, G-1, and SV-1 would not be protective of human health or the environment since no action is being taken to reduce site contamination or exposure routes. Although site access is restricted via fencing and security, and the groundwater in the area is not used for potable applications, these conditions may not continue. Under no action, there would be no provisions to limit this access and workers on property or residents on or off property can be exposed to COCs in soil through direct contact, ingestion, and inhalation. Groundwater could be extracted and used for various applications that would result in worker and resident exposure to COCs through dermal, ingestion, and inhalation pathways. During precipitation events, COCs in surface soils could erode from the site and flow into the recharge basins, north of the site.

Under current conditions, vapor intrusion to local housing is controlled through the SVE Containment System. Under the no action scenario, this system would no longer operate and vapors could again migrate off property and result in vapor intrusion. In addition, there would be no provisions for managing vapor intrusion into structures that may be constructed in the future.

The site COCs consist of PCBs, chlordane (a pesticide), SVOCs, metals, and/or VOCs in soil, soil vapor, and groundwater (Tables 3-4, 3-5, and 3-6). The soils represent a stand-alone media of concern for these COCs and also act as a COC reservoir for continuing impacts to soil vapor and groundwater that may otherwise attenuate. The concentrations of the pesticide, SVOCs, and VOCs would gradually decrease as a result of biodegradation and volatilization mechanisms. Hexavalent chromium would gradually convert into the trivalent form. However, PCBs in soil would be expected to remain indefinitely.

Currently, the ONCT system is used to capture and treat VOC-impacted groundwater from the NWIRP. If the PCBs or metals in on-property groundwater migrate to the ONCT without sufficient attenuation, the ONCT system would extract the impacted groundwater and then discharge it with little or no treatment of PCBs or metals in the groundwater. This groundwater would be discharged to the basins and then flow off property. In long term, the VOCs in groundwater would be remediated and the ONCT system could be shut down; however, there remains a potential for migration of PCB- and metal-impacted groundwater if they remain.

Compliance with ARARs:

Alternatives S-1, G-1, and SV-1 would not comply with the chemical-specific ARARs. Soils contain PCBs greater than New York State Soil Cleanup Objectives (10 NYCRR Part 375) and there would be no action taken to isolate them from human contact or the environment. Groundwater contains PCBs greater than New York State Public Water Supply Regulations (10 NYCRR Part 5-1) and the New York State Water Classification and Quality Standards (6 NYCRR 701 and 702). Soil vapors contain VOCs at concentrations that exceed NYSDOH Air Guideline Values. Without continued operation of the SVE Containment System, these vapors could migrate and impact existing off-property housing or potential future on-property structures.

Long-term Effectiveness and Permanence:

Alternatives S-1, G-1, and SV-1 would not be effective in the long term. Although the pesticide, VOCs, SVOCs, and metals would slowly attenuate and the risks associated with these COCs decrease accordingly, PCBs would remain in soil for an extended duration. There would be no controls in place to monitor potential effects to human health or the environment. Approximately 144,000 cubic yards of contaminated soil would remain at the site.

Reduction of Toxicity, Mobility, and Volume through Treatment:

There would be no reduction of toxicity, mobility, or volume through treatment under this alternative. The pesticide, SVOCs, and VOCs (via degradation and volatilization), and metals (hexavalent chromium reduction) in soil would slowly attenuate. As VOCs and metals in soil attenuate, impacts to soil vapor and groundwater would decrease. In addition, metals and PCBs in groundwater would slowly attenuate as they migrate. PCBs and metals would remain in soil indefinitely.

Short-term Effectiveness:

Since no action would be taken, there would be no risk to human health during implementation of this alternative.

Implementability:

Because no actions are being conducted, this alternative would be technically easy to implement.

Cost:

There are no costs associated with Alternatives S-1, G-1, or SV-1.

5.2.2 Alternative S-2 – Permeable Cover, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), and Land Use Controls

This alternative includes excavation and offsite disposal of soil with greater than 10 mg/kg of PCBs to an estimated depth of approximately 9 feet bgs, installation of a soil/gravel/asphalt permeable cover (depending on the end use of the area) over the residual PCBs and other COCs greater than the PRGs, and LUCs to protect the cover and limit future activities (Figure 5-1). The excavation and offsite disposal would be conducted to offset the volume of material being brought onsite for the cover. The permeable covers at Dry Wells 20-08 and 34-07 would consist of structural materials to allow the use of heavy equipment. Surface soil with less than 10 mg/kg of PCBs and other COCs at less than the PRGs may be reused within the deeper excavation area. This alternative is similar to the OU1 ROD for Site 1. It reduces direct contact risk to contaminated soil and reduces the potential for continued leaching of soil contamination to groundwater. Optimization activities such as consolidation, reduction in the areal extent of the cover, and elevation and grading changes would be further developed in the design.

Development

For Alternative S-2, excavated soil would be characterized for PCBs and the other COCs. Soil with less than 10 mg/kg PCBs and other COCs less than PRGs would be reused/consolidated in the deeper excavation, whereas soil with greater than 10 mg/kg PCB would be disposed off site (estimated at 14,500 cubic yards).

For soil excavation, an assumed grading ratio of approximately 2 to 1 would be used to support excavation sidewalls. A portion of the excavation on the eastern edge of Site 1 along 11th Street may require piling and/or removal and replacement of a portion of the roadway. The excavation boundary for 0- to 2-foot bgs interval is approximately 4.5 acres and the excavation boundary for 2- to 9- foot bgs interval covers an area of approximately 2.3 acres, with an additional 0.75 acre of additional area required for the sloping. This excavation would also include consolidation of contaminated soil away from the site boundaries toward the center of the site and the deeper excavation. A windrow (mounded area of vegetated soil) is present along the eastern edge of the Site. This soil could potentially be reused and would likely need to be replaced once the excavation is complete. The soils to be handled would be unsaturated, as the water table is located at a depth of 50 feet bgs. Due to Site 1 being present in a commercialized area, limited space would be available for stockpiling soil, so the majority would be trucked off as the excavation is done in sections. After completion of the excavation, the area would be backfilled with reused site soil (PCBs less than 10 mg/kg and other COCs less than PRGs) and/or clean soil and re-graded.

Site 1 is underlain by approximately 120 sanitary cesspools (concrete lined-open earth wells 10 feet in diameter to a depth of 16 feet). The tops of these cesspools would be collapsed or removed (1,900 tons). In addition, an area of approximately 3,200 square feet was assumed for the portion of asphalt road that would require removal and replacement.

Approximately 14,500 cubic yards of soil containing an estimated 1,400 pounds of PCBs and other COCs would be disposed off property. An estimated 50 percent of the soil for offsite disposal is assumed to be classified as RCRA hazardous to be disposed in a RCRA Subtitle C landfill (and/or TSCA permitted landfill); with the remaining nonhazardous soil disposed in a RCRA Subtitle D landfill. Samples of the soil will be collected and analyzed to ensure that the soil complies with the landfill permits. Additionally, four groundwater monitoring wells (BPS1-TT-MW301 S, I and D, and BPS1-HN-MW27I would require removal and replacement.

Approximately 14,500 cubic yards of either gravel or asphalt would be required for the cap. LUCs would be in place to prevent future damage to the cap and/or use of remaining contaminated subsurface soil.

During the design and implementation, optimization steps may be taken to achieve similar results to that described in the alternative. These steps may include consolidation of residual contaminated soil to reduce the areal extent of the cover and reduce transportation and offsite disposal of contaminated soil.

<u>Detailed Analysis of Alternative</u>

Overall Protection of Human Health and the Environment:

Alternative S-2 is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment (recharge basin) would be eliminated via excavation, soil cover, and LUCs. In addition, the excavation, offsite disposal of a portion of the contaminated soil, and soil cover would reduce leaching of soil contamination to groundwater. However, the remaining contaminated soil could continue to impact groundwater and soil vapor for an extended period of time (e.g., greater than 30 years). Over the long run, the leaching of COCs to groundwater would be expected to decrease through depletion of the source material. Monitoring would be conducted to ensure the integrity of the cover, evaluate COC migration, and identify the need for additional action. LUCs would be used to provide notice of subsurface COCs and help to prevent damage to the soil cover and restrict access to contaminated media.

Compliance with ARARs:

This alternative would comply with ARARs for soil. Although COCs would remain at the site at concentrations that would not allow unrestricted use (e.g., NYSDEC Soil Clean Up Objectives Table 375-6), the use of the cover, removal of soils containing more than 10 mg/kg to a depth of 9 feet bgs, and LUCs would effectively minimize the potential for risk to human health. The removal of PCB-contaminated soil would also reduce leaching to groundwater, but the magnitude of the decrease (i.e., to less than MCLs and water quality standards) is uncertain. There are no location-specific ARARs for soil. This alternative would also comply with action-specific ARARs for management and characterization of contaminated wastes on site.

Long-term Effectiveness and Permanence:

Alternative S-2 would be moderately effective in the long term. Contaminated soil to a depth of approximately 9 feet bgs would be removed and replaced with consolidated site soil (PCBs less than 10 mg/kg and other COCs less than PRGs) or clean soil and covered to prevent direct contact risk to soil, inhalation of fugitive dusts, or erosion into the recharge basins. The partial excavation and soil cover would reduce infiltration of groundwater and leaching of soil contamination to groundwater. LUCs would be used to restrict use of the area to prevent damage to the cover and exposure to residual contaminated soil. The pesticide, VOC, and SVOC COCs would slowly degrade over time. Approximately 130,000 cubic yards of PCB- and metal-contaminated soil containing an estimated 6,100 pounds of PCBs would remain indefinitely at the site.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-2 would not reduce the toxicity, mobility or volume of contaminated soil through treatment. Approximately 1,400 pounds of PCBs in 14,500 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill. Additionally, remaining VOC-, SVOC- and pesticide-contaminated soil would degrade through natural in situ biological activities.

Short-term Effectiveness:

Alternative S-2 would be effective in the short term. Activities would consist of administrative actions, excavation and offsite disposal of the top 9 feet of soil contaminated with PCBs, and installation of a soil cover. The alternative would involve the transportation of contaminated soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and pesticide-, SVOC- and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community. Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation and installation of the soil cover, approximately 5 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Over time, the leaching would be expected to decrease to levels below current conditions. Although there is the potential for site worker exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation, consolidation, covering, and offsite disposal. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community.

Cost:

The estimated costs associated with Alternative S-2 are as follows.

Capital Cost:	$12,900,000
O&M:	$12,800 per year, over 30 years (Cover Maintenance)
	$30,000 every five years, over 30 years (Five-Year Review and LUCs)
Present Value:	$13,400,000 (30 years)

5.2.3 Alternative S-3 – RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), and Land Use Controls

This alternative includes limited excavation and offsite disposal of soil with greater than 25 mg/kg of PCBs, installation of a RCRA Cap cover over the residual PCBs and other COCs greater than the PRGs, and LUCs to protect the cap and limit future activities (Figure 5-2). The excavation and offsite disposal would be conducted to partially offset the volume of material being brought onsite for the cap. Surface soil with less than 25 mg/kg of PCBs and other COCs at less than PRGs may be reused within the deeper excavation area. This alternative reduces direct contact risk to contaminated soil and effectively eliminates continued leaching of unsaturated soil contamination to groundwater via precipitation infiltration. A concrete-based cap may be used in place of the RCRA cap in areas where heavy vehicle traffic occurs (e.g., dry wells 20-08 and 34-07). Optimization activities such as consolidation, reduction in the areal extent of the cover, and elevation and grading changes would be further developed in the design.

Development

For Alternative S-3, a partial excavation would be conducted to remove soil containing greater than 25 mg/kg PCBs to an approximate depth of 10 feet bgs (see Figure 5-2). Excavated soil would be characterized for PCBs and the other COCs. Soil with less than 25 mg/kg PCBs and other COCs less than PRGs would be reused and/or consolidated onsite, whereas soil with greater than 25 mg/kg PCB would be disposed off site. The volume of soil for offsite disposal (approximately 7,200 cubic yards) is based on the average removal of one foot of soil across the site prior to the construction of the cap.

The excavation boundary for 0- to 2-foot bgs interval is approximately 4.5 acres and the excavation boundary for 2- to 10- foot bgs interval covers an area of approximately 1 acre, with an additional 0.75 acre of additional area required for the sloping. This excavation would also include consolidation of contaminated soil away from the site boundaries toward the center of the site and the deeper excavation. After completion of the excavation, the area would be backfilled with reused site soil (PCBs less than 25 mg/kg) and/or clean soil and re-graded.

Approximately 7,200 cubic yards of soil containing an estimated 1,100 pounds of PCBs and other COCs would be disposed off property. An estimated 75 percent of the soil for offsite disposal is assumed to be classified as RCRA hazardous to be disposed in a RCRA Subtitle C landfill (and/or TSCA landfill); with the remaining nonhazardous soil disposed in a RCRA Subtitle D landfill. Samples of the soil will be collected and analyzed to ensure that the soil complies with the landfill permits.

Site 1 is underlain by approximately 120 sanitary cesspools (concrete lined - open earth wells 10 feet in diameter to a depth of 16 feet). During the soil excavation, the tops of these cesspools would be collapsed or removed to provide a stable subsurface. Approximately 1,900 tons of concrete would be effected.

There are several variations on an impermeable cap that can be used. For Alternative S-3, the cap would consist of (from bottom up) a geotextile, a 24-inch clay/synthetic composite cap, a geotextile, a 12-inch drainage layer, a geotextile, and a 24 inch soil/top soil layer. Based on the planned area use, the cap system would be overlain by gravel, asphalt, or vegetation. The total volume of the cap system materials is approximately 37,000 cubic yards. LUCs would be in place to prevent future damage to the cap and/or use of remaining contaminated subsurface soil.

During the design and implementation, optimization steps may be taken to achieve similar results to that described in the alternative. These steps may include consolidation of residual contaminated soil to reduce the areal extent of the cap and transportation and offsite disposal of contaminated soil.

<u>**Detailed Analysis of Alternative**</u>

Overall Protection of Human Health and the Environment:

Alternative S-3 is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment would be eliminated via excavation, capping, and LUCs. The excavation and RCRA cap would minimize leaching of contamination from unsaturated soil to groundwater. Contamination in saturated soil would continue to leach to groundwater, for an extended period of time. Over the long run, the leaching of contaminates to groundwater would be expected to decrease through depletion of the source and active contact between the COCs and groundwater flow. Monitoring would be conducted to ensure the integrity of the cap. LUCs would be used to provide notice of subsurface COCs and help to prevent damage to the cap and restrict access to contaminated media.

Compliance with ARARs:

This alternative would comply with ARARs for soil. Although COCs would remain at the site at concentrations that would not allow unrestricted use (e.g., NYSDEC Soil Clean Up Objectives Table 375-6.8(a)), the use of the cap, removal of soils containing more than 25 mg/kg to a depth of approximately 10 feet bgs, and LUCs would effectively minimize the potential for risk to human health. The removal of PCB contaminated soil and the RCRA cap would also reduce leaching of COCs from unsaturated soil to groundwater. There are no location specific ARARs for soil. This alternative would also comply with action-specific ARARs for management and characterization of contaminated wastes on site.

Long-term Effectiveness and Permanence:

Alternative S-3 would be moderately effective in the long term. Contaminated soil to a depth of approximately 10 feet bgs would be removed and replaced with consolidated site soil or clean soil and covered to prevent direct contact risk to soil or inhalation of fugitive dusts. The RCRA cap would also effectively control infiltration of groundwater and leaching of COCs from unsaturated soil to groundwater.

LUCs would be used to restrict use of the area to prevent damage to the cap and exposure to residual contaminated soil. The pesticide, VOC, and SVOC COCs would slowly degrade over time. A calculated 137,000 cubic yards of PCB- and metal-contaminated soil containing approximately 6,400 pounds of PCBs would remain at the site.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-3 would not reduce the toxicity, mobility or volume of contaminated soil through treatment. Approximately 1,100 pounds of PCBs in 7,200 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill. Remaining VOC-, SVOC-, and pesticide-contaminated soil would degrade through natural in situ biological activities.

Short-term Effectiveness:

Alternative S-3 would be effective in the short term. Activities would consist of administrative actions, excavation and offsite disposal of a portion of the soil contaminated with PCBs, and installation of a RCRA cap. The Alternative would involve the transportation of waste soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community. Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation and installation of the cap, approximately 6 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Over time, the leaching would be expected to decrease to levels below current conditions. Although there is the potential for exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation, consolidation, capping, and offsite disposal. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community.

Cost:

The estimated costs associated with Alternative S-3 are as follows.

Capital Cost: $14,600,000

O&M: $12,800 per year, over 30 years (Cap Maintenance)

$30,000 every five years, over 30 years (Five-Year Review and LUCs)

Present Value: $15,000,000 (30 years)

5.2.4 Alternative S-4 – RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, and Land Use Controls

This Alternative is similar to Alternative S-3 in that it includes partial excavation of PCB-contaminated soils, installation of a RCRA cap over the residual PCBs and other COCs greater than the PRGs, and LUCs.

Alternative S-4 also includes the installation of a vertical barrier to approximately 80 feet bgs (15 feet below the bottom of the soil contamination) to control horizontal migration of PCBs from saturated soil (Figure 5-3). Horizontal migration of soil vapor would also be controlled.

Development

Except for the vertical barrier discussed below, the development of Alternative S-4 is the same as Alternative S-3. As groundwater naturally flows through contaminated soil, it becomes impacted. A vertical barrier made of low-permeability materials would be constructed to encircle contaminated soil. This barrier would then prevent/control the migration of contaminated groundwater at Site 1 and Dry Well 20-08, both of which have PCB-contaminated saturated soil. Dry Well 34-07 does not have PCB-contaminated saturated soil associated with it. Injected material would be delivered via jet grouting which uses high pressure nozzles to form solid in-situ columns. The grout would consist of cement and bentonite, which would mix with the natural sands and gravels in the formation and then set. Based on the natural materials present, the cylinders would be up to several feet in diameter. For Alternative S-4, 3-foot diameter columns would likely be formed. The columns would be installed to create an overlapping wall of concrete that would include approximately 50 percent of Site 1 and Dry Well 20-08. Based on 3-foot diameter columns, approximately 1,100 columns would be needed to complete a vertical barrier (see Appendix B).

The injection of the grout would result in the formation of approximately 3,500 cubic yards of additional waste material (15 percent of the barrier wall volume) for offsite disposal or onsite consolidation. Several options for the vertical barrier are available. Because of the depth of the barrier, in-situ jet grouting was selected as a representative option.

During the design and implementation, optimization steps may be taken to achieve similar results to that described in the alternative. These steps may include consolidation of residual contaminated soil to reduce the areal extent of the cap and vertical barriers and reduce transportation and offsite disposal of contaminated soil.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative S-4 is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment would be eliminated via excavation, capping and LUCs. The excavation and RCRA cap would prevent leaching of contamination from unsaturated soil to groundwater and the vertical barrier would prevent horizontal migration of groundwater in contact with saturated soil. Monitoring would be conducted to ensure the integrity of the cap and horizontal barrier. LUCs would be used to provide notice of subsurface contamination and help to prevent damage to the cap and restrict access to contaminated media.

Compliance with ARARs:

This alternative would comply with ARARs for soil. Although COCs would remain at the site at concentrations that would not allow unrestricted use (e.g., NYSDEC Soil Clean Up Objectives Table 375-

6.8a), the use of the cap, removal of soils containing more than 25 mg/kg of PCBs to a depth of approximately 10 feet bgs, and LUCs would effectively minimize the potential for risk to human health. The removal of PCB-contaminated soil, the RCRA cap, and vertical barriers would also reduce leaching of COCs from unsaturated soil to groundwater and migration of contaminated groundwater. There are no location specific ARARs for soil. This alternative would also comply with action-specific ARARs for management and characterization of contaminated wastes on site and the Underground Injection Control (UIC) (40 C.F.R. 144.81 and 0.82).

Long-term Effectiveness and Permanence:

Alternative S-4 would be moderately effective in the long term. Contaminated soil to a depth of approximately 10 feet bgs would be removed and replaced with consolidated site soil or clean soil and covered to prevent direct contact risk to soil or inhalation of fugitive dusts. The RCRA cap would effectively vertical control infiltration of groundwater and leaching of contamination from unsaturated soil to groundwater. A barrier would prevent contaminated groundwater from migrating beyond Site 1. LUCs would be used to restrict use of the area to prevent damage to the cap and exposure to residual contaminated soil. The pesticide, VOC, and SVOC COCs would slowly degrade over time. A calculated 137,000 cubic yards of PCB- and metal-contaminated soil containing approximately 6,400 pounds of PCBs would remain at the site.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-4 would not reduce the toxicity, mobility or volume of contaminated soil through treatment. Approximately 1,100 pounds of PCBs in 7,200 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill. An additional 3,500 cubic yards of waste material from the formation of the vertical barriers would be generated and require either on site reuse or offsite disposal. Remaining VOC-, SVOC- and pesticide-contaminated soil would degrade through natural in situ biological activities.

Short-term Effectiveness:

Alternative S-4 would be effective in the short term. Activities would consist of administrative actions, excavation and offsite disposal of a portion of soil contaminated with PCBs and other COCs, and installation of a RCRA cap and a vertical barrier. The alternative would involve the transportation of waste soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community. Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation and installation of the cap, approximately 7 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Over time, the leaching would be expected to decrease to levels below current conditions. Although there is the potential for exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation, consolidation, capping and offsite disposal. Implementation of the vertical barrier is less common, but vendors are available to perform the work. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community.

Cost:

The estimated costs associated with Alternative S-4 are as follows.

Capital Cost: $24,000,000

O&M: $12,800 per year, over 30 years (Cap Maintenance)

$30,000 every five years, over 30 years (Five-Year Review and LUCs)

Present Value: $24,500,000 (30 years)

5.2.5 Alternative S-5A – Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solidification of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls

This alternative is similar to Alternative S-3 in that it includes partial excavation of PCB-contaminated soils, installation of a RCRA cap cover over the residual PCBs and other COCs greater than the PRGs, and LUCs. Alternative S-5A also includes the in-situ solidification of PCB-contaminated soil, containing greater than 50 mg/kg of PCBs (Figure 5-4). This treatment would encapsulate the higher concentration PCB-contaminated soil within a cement/bentonite or similar matrix.

<u>Development</u>

Except for the in-situ solidification discussed below, the development of Alternative S-5A is same as Alternative S-3. The in-situ solidification construction technique is similar to that for the vertical barriers described in Alternative S-4 in that approximately 3-foot diameter columns would be formed throughout the site via jet grouting. Alternative methods, such as the use of augers, is also potentially feasible.

Because of the ability to treat the soils in three dimensions, an extensive pre-treatment sampling program would be conducted. Approximately one sample will be collected in a grid pattern for each 20-foot by 20-foot by 10-foot thick cell, (or every 150 cubic yards), within the attainment area. For the estimated volume of the attainment area of approximately 82,000 cubic yards, 540 samples would be collected and analyzed for PCBs. The volume of soil for treatment is estimated to represent 10 to 30 percent of the volume of tested soil within the attainment area, or an average of approximately 16,000 cubic yards of soil containing greater than 50 mg/kg of PCBs. The injection of the grout would result in the formation of approximately 2,400 cubic yards of waste material (15 percent of the treatment volume) for offsite disposal or onsite consolidation.

During the design and implementation, optimization steps may be taken to achieve similar results to that described in the alternative. These steps may include consolidation of residual contaminated soil to reduce the areal extent of the cap and vertical barriers and/or reduce the need for offsite transportation and disposal of contaminated soil.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative S-5A is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment would be eliminated via excavation, capping, and LUCs. The excavation, in-situ solidification, and RCRA cap would prevent leaching of contamination from unsaturated and saturated soil to groundwater and the in-situ solidification would reduce horizontal migration of groundwater in contact with saturated soil. Monitoring would be conducted to ensure the integrity of the cap and solidification. LUCs would be used to provide notice of subsurface contamination and help to prevent damage to the cap and restrict access to contaminated media.

Compliance with ARARs:

This alternative would comply with ARARs for soil. Although COCs would remain at the site at concentrations that would not allow unrestricted use (e.g., NYSDEC Soil Clean Up Objectives Table 375-6.8a), the use of the cap, removal of soils containing more than 25 mg/kg PCBs to a depth of approximately 10 feet bgs, in-situ solidification of soils containing more than 50 mg/kg PCBs at depths of approximately 10 to 65 feet bgs, and LUCs would effectively minimize the potential for risk to human health. The removal or solidification of PCB-contaminated soil, and the RCRA cap would also reduce leaching of COCs from unsaturated soil to groundwater and migration of contaminated groundwater. There are no location specific ARARs for soil. This alternative would also comply with action-specific ARARs for management and characterization of contaminated wastes on site and the Underground Injection Control (UIC) (40 C.F.R. 144.81 and 0.82).

Long-term Effectiveness and Permanence:

Alternative S-5A would be moderately effective in the long term. Contaminated soil to a depth of approximately 10 feet bgs would be removed and replaced with consolidated site soil or clean soil and covered to prevent direct contact risk to soil or inhalation of fugitive dusts. The RCRA cap and in-situ solidification would effectively control infiltration of groundwater and leaching of contamination from unsaturated soil to groundwater. LUCs would be used to restrict use of the area to prevent damage to the cap and exposure to residual contaminated soil. The pesticide, VOC, and SVOC COCs would slowly degrade over time. A calculated 137,000 cubic yards of PCB- and metal-contaminated soil containing approximately 6,400 pounds of PCBs would remain at the site of which 3,300 pounds would be treated. The remaining untreated PCBs would be present in soil at concentrations less than 50 mg/kg. LUCs would be used to restrict use of the area to prevent damage to the cap.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-5A would reduce the mobility of 3,300 pounds of PCBs in 16,000 cubic yards of contaminated soil through solidification. Also, approximately 1,100 pounds of PCBs in 7,200 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill. An additional 2,400 cubic yards of treated soil from the solidification process would be generated and require either on site reuse or offsite disposal. Remaining VOC-, SVOC-, and pesticide-contaminated soil would degrade through natural in situ biological activities.

Short-term Effectiveness:

Alternative S-5A would be effective in the short term. Activities would consist of administrative actions, excavation and offsite disposal of the top 10 feet of soil contaminated with PCBs, and installation of a RCRA cap and in-situ solidification. The alternative would involve the transportation of waste soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community.

Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation, in-situ solidification, and installation of the cap, approximately 8 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Over time, the leaching would be expected to decrease to levels below current conditions. Although there is the potential for exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation, consolidation, capping, and offsite disposal. Implementation of the in-situ solidification is less common, with limited vendors available to perform the work. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community.

Cost:

The estimated costs associated with Alternative S-5A are as follows.

Capital Cost:	$23,600,000
O&M:	$12,800 per year, over 30 years (Cap Maintenance)
	$30,000 every five years, over 30 years (Five-Year Review and LUCs)
Present Value:	$24,000,000 (30 years)

5.2.6 Alternative S-5B – RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, In-situ Solvent Extraction of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls

This alternative is similar to Alternative S-4 in that it includes partial excavation of PCB-contaminated soils, installation of vertical barriers and a RCRA cap cover over the residual PCBs and other COCs greater than the PRGs and LUCs. Alternative S-5B also includes the in-situ solvent extraction of PCB-contaminated soil, containing greater than 50 mg/kg PCBs (Figure 5-5). This treatment would remove PCBs from contaminated soil. Following treatment, a supplemental technology, such as biosparging, would be used to treat the residual solvent.

Development

Except for the in-situ solvent extraction discussed below, the development of Alternative S-5B is same as Alternative S-4. In-situ solvent extraction of soils would be completed by injecting a biodegradable organic solvent (e.g. VertecBio Gold #4) into saturated and unsaturated soils. The solvent would flow downward through the unsaturated soils, or upward in the saturated soil and form a floating free product on the water table. The solvent would extract organics, including PCBs, pesticides, and SVOCs from the soil. The solvent would then be recovered from the underlying aquifer via extraction wells and disposed off site or recovered via physical processes, such as distillation, or a selective dehalogenation process using potassium polyethylene glycol. For this FS, it is assumed that the contaminated solvent would be disposed off site via incineration. Solvent that could not be recovered, would be degraded in-situ through an air sparge system and natural biodegradation. Installation of vertical barriers is needed to ensure containment of the injected solvent.

Approximately 1,200,000 gallons of VertecBio Gold #4 would be needed to remove approximately 4,200 pounds of PCBs. Solvent injection would be conducted with injection points located below the water table and above the contaminated soil. The injection points are assumed to be located approximately every 10 feet. Solvent recovery wells would be located at the water table and are assumed to be located approximately every 40 feet. For the biosparging component of the remedy, air sparge wells would use a portion of the deep injection points and vapor extraction wells would use the solvent recovery wells. Wells would be made of either 1 inch or 2 inch PVC, and located at depths based on well type. Solvent injection and dual solvent injection/air sparge wells would be screened at either 10 or 75 feet bgs, and solvent recovery wells would be screened between at a depth of 40 to 60 feet bgs with 20 foot well screens (to account for a fluctuating water table which is located at 50 feet bgs). A blower that produces 335 cubic feet per minute (CFM) at 19 horsepower (HP) would be required for the joint air sparge system for Site 1 and the Dry Wells. The blower and other relevant equipment would be housed in a 20-foot by 40-foot building at Site 1. Piping would be run to surrounding Dry Wells 20-08 and 34-07.

During the design and implementation, optimization steps may be taken to achieve similar results to that described in the alternative. These steps may include consolidation of contaminated soil to reduce treatment areas or the areal extent of the cap and vertical barriers, recovery and dechlorination of the solvent, and reduce transportation and offsite disposal of contaminated soil.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative S-5B is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment would be eliminated via excavation, capping, solvent extraction, and LUCs. The excavation, in-situ solvent extraction, vertical barriers, and RCRA cap would prevent leaching of contamination from unsaturated soil to groundwater and reduce leaching from saturated soil to groundwater. LUCs would be used to provide notice of subsurface contamination and help to prevent damage to the soil cover and restrict access to contaminated media.

Compliance with ARARs:

This alternative would comply with chemical-specific ARARs for soil including NYSDEC Soil Cleanup Objectives for Commercial Use (10 NYCRR Part 375-6b), location-specific ARARs for management of a contaminated site (6 NYCRR 375 Parts 1.1 to 1.12), and action-specific ARARs for characterization and identification of wastes (6 NYCRR 371.3, 372.2, 373-1.1), Underground Injection Control (UIC) (40 C.F.R. 144.81 and 0.82), and because of the solvent, federal and State ARARs for the management of fuels and oil (40 C.F.R. 112.3- to .6 and 6 NYCRR Parts 615.8 to .14).

Long-term Effectiveness and Permanence:

Alternative S-5B would be moderately effective in the long term. Contaminated soil to a depth of approximately 10 feet bgs would be removed and replaced with consolidated site soil or clean soil and covered to prevent direct contact risk to soil or inhalation of fugitive dusts. The RCRA cap, in-situ solvent extraction, and vertical barriers would effectively control infiltration of groundwater and leaching of contamination from unsaturated and saturated soil to groundwater. LUCs would be used to restrict use of the area to prevent damage to the cap and exposure to residual contaminated soil. The pesticide, VOC, and SVOC COCs would slowly degrade over time. A calculated 61,000 cubic yards of PCB- and metal-contaminated soil containing approximately 2,300 pounds of PCBs would remain. The remaining PCBs would be present in soil at concentrations less than 50 mg/kg, with an average concentration of approximately 12 mg/kg. A vertical barrier would prevent contaminated groundwater from migrating beyond Site 1 or the migration of solvent.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-5B would result in the removal of approximately 4,200 pounds of PCBs from approximately 76,000 cubic yards of PCB-contaminated soil. This action would generate 740,000 gallons of waste solvent for disposal (i.e., offsite incineration) or onsite treatment and reuse (potassium polyethylene glycol), both of which would permanently destroy PCBs. Also, approximately 1,100 pounds of PCBs in 7,200 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill. Remaining VOC-, SVOC- and pesticide-contaminated soil would degrade through natural in situ biological activities.

Short-term Effectiveness:

Alternative S-5B would be effective in the short term. Activities would consist of administrative actions, partial excavation and offsite disposal of soil contaminated with PCBs, installation of a RCRA cap, and in-situ solvent extraction. The alternative would involve the transportation of waste soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community.

Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation, in-situ solidification, and installation of the cap and vertical barrier, approximately 11 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Although there is the potential for exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation, consolidation, capping, and offsite disposal. Implementation of the vertical barrier is less common, with limited vendors available to perform the work. Implementation of the in-situ solvent extraction would be considered an innovative technology that would have to be developed specifically for this site. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community

Cost:

The estimated costs associated with Alternative S-5B are as follows.

Capital Cost: $41,900,000

O&M: 12,800 per year, over 30 years (Cap Maintenance)

$47,500 per year, over 5 years (Air Sparging)

$30,000 every five years, over 30 years (Five-Year Review and LUCs)

Present Value: $42,800,000 (30 years)

5.2.7 Alternative S-6: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), Soil Cover, and Land Use Controls

Alternative S-6 includes excavation and offsite disposal of PCB-contaminated soils with greater than 10 mg/kg and other COCs greater than the PRGs, installation of a cover over the residual PCBs, consolidation of PCB-contaminated soils with 1 to 10 mg/kg PCBs under the cover, and LUCs. The shallow excavation and off-site disposal, soil cover, and land use controls for Alternative S-6 are similar to Alternative S-2. However, this alternative would also involve the excavation and offsite disposal of deeper soil, including saturated soil (Figure 5-6). Also, soil with other COCs at concentrations greater than the PRGs would be addressed with this excavation. This alternative is considered to minimize direct contact risk with contaminated soil and leaching of COCs to groundwater.

Development

This alternative would include the excavation and offsite disposal of PCB-contaminated soil with greater than 10 mg/kg, including soil to a depth of 65 feet bgs. To excavate the deeper soil, piling or equivalent measures would be used to support the excavation sidewalls during construction. Also, since the water table at this site is located at approximately 50 feet bgs, meaning that up to 15 feet of the excavation depth is saturated, the deepest soil would need to be dredged or the excavation dewatered.

Under this alternative, approximately 94,000 cubic yards of contaminated soil would be excavated and the majority of it disposed off site (e.g., 73,000 cubic yards). Based on testing, a portion of the soil (i.e., PCBs with less than 10 mg/kg of PCBs), could be reused on site (21,000 cubic yards).

The sidewalls of the excavation would be sampled to confirm that PRGs were delineated with the horizontal extent of contamination. After completion of the excavation, the area would be backfilled with clean soil and re-graded.

During the design and implementation, optimization steps may be taken to achieve similar results to that described in the alternative. These steps may include consolidation of residual contaminated soil to reduce the areal extent of the cover.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative S-6 is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment would be eliminated via excavation and offsite disposal, soil cover, and LUCs. The excavation and offsite disposal and soil cover would minimize leaching of contamination from unsaturated and saturated soil to groundwater. LUCs would be used to provide notice of subsurface contamination and help to prevent damage to the soil cover and restrict access to contaminated media.

Compliance with ARARs:

This alternative would comply with chemical-specific ARARs for soil including NYSDEC Soil Cleanup Objectives for Commercial Use (10 NYCRR Part 375-6b), location-specific ARARs for management of a contaminated site (6 NYCRR 375 Parts 1.1 to 1.12), and action-specific ARARs for characterization and identification of wastes (6 NYCRR 371.3, 372.2, 373-1.1).

Long-term Effectiveness and Permanence:

Alternative S-6 would be effective in the long term. Contaminated soil to a depth of approximately 65 feet bgs would be removed and replaced with consolidated site soil or clean soil and covered to prevent direct contact risk to soil or inhalation of fugitive dusts. The removal of the majority of PCBs and the soil cover would effectively reduce the migration of COCs to groundwater. LUCs would be used to restrict use of the area to prevent damage to the cover and exposure to residual contaminated soil. The VOC, SVOC and pesticide COCs would slowly degrade over time. Approximately 71,000 cubic yards of PCB-contaminated soil containing approximately 1,100 pounds of PCBs and metals would remain. The remaining PCBs would be present in soil at concentrations less than 10 mg/kg, with an average concentration of approximately 5 mg/kg. LUCs would be used to restrict use of the area to prevent damage to the soil cover.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-6 would not result in the reduction in toxicity, mobility, or volume through treatment. Approximately 6,400 pounds of PCBs in 73,000 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill. Remaining VOC-, SVOC- and pesticide-contaminated soil would degrade through natural in situ biological activities.

Short-term Effectiveness:

Alternative S-6 would be effective in the short term. Activities would consist of administrative actions, excavation and offsite disposal of soil contaminated with PCBs, and installation of a soil cover. The Alternative would involve the transportation of waste soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community.

Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation and offsite disposal and installation of a soil cover, approximately 7 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Although there is the potential for exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation, offsite disposal, and installation of a soil cover. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community.

Cost:

The estimated costs associated with Alternative S-6 are as follows.

Capital Cost: $60,100,000

O&M: $12,800 per year, over 30 years (Cap Maintenance)

$30,000 every five years, over 30 years (Five-Year Review and LUCs)

Present Value: $60,600,000 (30 years)

5.2.8 Alternative S7: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 1 mg/kg)

Alternative S-7 includes excavation and offsite disposal of PCB-contaminated soil with greater than 1 mg/kg and other COCs greater than PRGs. The excavation would then be backfilled with clean soil. This alternative is similar to Alternative 6 and includes potential reuse of clean soils that were excavated to support slope stability. Because all of the contaminated soil is removed from the site, it would not require the use of a soil cover or land use controls, (Figure 5-7). This alternative is considered to minimize direct contact risk with contaminated soil and leaching of COCs to groundwater.

Development

This alternative would include the excavation and offsite disposal of PCB-contaminated soil with greater than 1 mg/kg and other COCs greater than PRGs, including soil to a depth of 65 feet bgs. To excavate the deeper soil, piling or equivalent measures would be used to support the excavation sidewalls during construction. Also since the water table at this site is located at approximately 50 feet bgs, meaning that up to 15 feet of the excavation depth is saturated, the deepest soil would need to be dredged or the excavation dewatered.

Under this Alternative, approximately 178,000 cubic yards of contaminated soil would be excavated and the majority of it disposed off site (e.g., 144,000 cubic yards). Based on testing, a portion of the soil (i.e., PCBs with less than 1 mg/kg and other COCs less than PRGs), could be reused on site (34,000 cubic yards).

The sidewalls of the excavation would be sampled to confirm that PRGs were delineated with the horizontal extent of contamination. After completion of the excavation, the area would be backfilled with clean soil and re-graded.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative S-7 is expected to be protective of human health and the environment because the direct contact risk (exposure to COCs) and migration of contaminated soil to surface water and sediment would be eliminated via excavation and offsite disposal. Excavation and offsite disposal would minimize leaching of contamination from unsaturated and saturated soil to groundwater.

Compliance with ARARs:

This alternative would comply with chemical-specific ARARs for soil including NYSDEC Soil Cleanup Objectives for Residential Use (10 NYCRR Part 375-6b), location-specific ARARs for management of a contaminated site (6 NYCRR 375 Parts 1.1 to 1.12), and action-specific ARARs for characterization and identification of wastes (6 NYCRR 371.3, 372.2, 373-1.1).

Long-term Effectiveness and Permanence:

Alternative S-7 would be effective in the long term. Contaminated soil to a depth of approximately 65 feet bgs would be removed and replaced with consolidated site soil or clean soil to prevent direct contact risk to soil or inhalation of fugitive dusts. The removal of the PCBs would effectively reduce the migration of COCs to groundwater. No contaminated soil would remain at the site.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative S-7 would not result in the reduction in toxicity, mobility, or volume through treatment. Approximately 7,500 pounds of PCBs in 144,000 cubic yards of contaminated soil would be removed from the site and disposed in an offsite landfill.

Short-term Effectiveness:

Alternative S-7 would be effective in the short term. Activities would consist of administrative actions, excavation and offsite disposal of soil contaminated with PCBs. The Alternative would involve the transportation of waste soil off site and potential removal and replacement of a portion of 11th Street, which would affect the surrounding community and environment. In addition, VOC vapors and PCB-contaminated dust would be generated during the excavation, loading, and transportation of the soil. Monitoring and dust suppression activities (such as wetting the soil) would be conducted to be protective of the community.

Compliance with the RAOs for prevention of direct contact risk would be achieved upon completion of the excavation and offsite disposal, approximately 10 years after the signing of the ROD. Initially, because of soil disturbances, leaching of site COCs to groundwater would increase. Although there is the potential for exposure to contaminated soils during excavation, the appropriate personal protective equipment (PPE) would mitigate risks.

Implementability:

Vendors and equipment are available to implement this alternative, including excavation and offsite disposal. Site 1 is located in a commercialized area, and trucking removal activities would need to be planned to be considerate of the surrounding community.

Cost:

The estimated costs associated with Alternative S-7 are as follows.

Capital Cost: $99,700,000

O&M: $0

Present Value: $99,700,000

5.2.9 Alternative SV-2 – Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System

Alternative SV-2 is the continuing operation, maintenance, and monitoring of the existing SVE Containment System, plus the addition of land use control specific to vapor intrusion (Figure 5-8). The human health risk assessment identified tetrachloroethene and trichloroethene in soil vapor as COCs. The existing system would continue to use the 12 existing vapor extraction wells (SVE-101I to SVE-106I and SVE-101D to SVE-106D) and the existing soil vapor pressure monitors [SVPMs]. The existing vapor phase GAC would continue to be used to remove the VOCs prior to discharge as required by state air discharge requirements. LUCs would be used to identify the need to control potential vapor intrusion exposure for any newly constructed structures on the site.

<u>Development</u>

The existing SVE Containment System has been evaluated and determined to effectively form a vacuum barrier to prevent migration of contaminated soil vapors off property and has effectively purged VOCs from off-property soil vapor. Monitoring would include sampling of existing off-property piezometers (11 off-property in total, 2001-2011), quarterly sampling of SVE wells (as part of the existing SVE Containment System, 17 in total), quarterly sampling for soil vapor pressure monitors (13 SVPMs), and monthly air sampling for regulatory compliance.

Based on the soil remedy selected, modifications to the physical system or operation may be required to maintain effectiveness or optimize performance. A soil cover over Site 1 is not expected to have a significant impact on the existing system. A RCRA cap, which would limit air infiltration for the western portion of the extraction system, would be expected to expand the capture zone of the existing SVE wells, and may require the extraction rates to be reduced to avoid interference with a similar system operating at the Bethpage Community Park. Other alternatives such as vertical barriers, in-situ treatment of PCB-contaminated soil, or excavations may significantly reduce or eliminate the need for long term operation of the SVE Containment System. During implementation of the soil alternatives, the SVE Containment System would continue to be operated to help reduce potential VOCs emissions.

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative SV-2 would be protective of human health and the environment because exposure to contaminated vapors would be controlled by maintaining a vacuum barrier in the soil between Site 1 and the residential neighborhood. Monitoring would continue to be conducted to ensure that the SVE Containment System remains protective. LUCs would be used to provide notice of residual VOC contamination and the need to take appropriate actions to control the potential for vapor intrusion.

Compliance with ARARs:

This alternative would comply with chemical-specific ARARs for NYSDOH Air Guideline Values [NYSDOH Soil Vapor Intrusion Guidance (2006), Table 3.1 Indoor Air and Table 3.3 Subslab Vapor (Matrix 1 and 2)] and NYSDOH Air Toxics Control Program (6 NYCRR Part 212 DAR-1 AGC/SGC Tables), and action-specific ARARs for the control and prevention of air pollutants (6 NYCRR 212.9).

Long-term Effectiveness and Permanence:

Alternative SV-2 would be effective in the long term. Contaminated vapors would be contained by the existing SVE Containment System to prevent migration of VOCs into surrounding buildings or neighborhoods. Eventually, VOCs in soil vapor would attenuate and the potential for vapor intrusion would no longer be present. At that time, the SVE Containment System could be shut down.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative SV-2 reduces the volume of contaminated soil vapor by extracting it and treating it via GAC, prior to discharge to the atmosphere. The GAC would be taken off site for landfilling or regeneration, during which VOCs would be permanently destroyed. Any residual VOCs discharged to the air would be destroyed through photochemical oxidation. The SVE Containment System removes approximately 12 pounds per year of TCE and PCE (see Appendix B).

Short-term Effectiveness:

For Alternative SV-2, activities would consist of administrative actions, a vapor monitoring program including sampling of existing SVE wells and monitoring of off-property piezometers and SVPMs. LUCs would prevent exposure to contaminated vapors while COCs attenuate. This alternative would provide for O&M of the existing SVE Containment System, which would protect against migration of contaminated vapors while attenuation occurs. The time required for the soil vapors to cleanup to the point that the Containment System can be shut down is uncertain, especially when the effects of the soil remedies are considered, but the duration is expected to exceed 30 years. By removing the source or providing vertical containment, active soil remedies would be expected to reduce the time required for operation of the SVE Containment System.

Implementability:

Vendors and equipment are readily available to maintain, operate and monitor the system. Currently, the SVE Containment System treats vapors contaminated with TCE and PCE with granular activated carbon. There are no additional construction requirements anticipated with this alternative. Existing operation, maintenance, and monitoring requirements would continue.

Cost:

The estimated costs associated with Alternative SV-2 are as follows.

Capital Cost: $0

O&M: $100,000 per year, over 30 years (O&M)

$15,000 every five years, over 30 years (Five-Year Review and LUCs, incremental to the Soil Five-Year Review and LUCs)

Present Value: $2,600,000 (30 years)

5.2.10 Alternative SV-3 – Soil Vapor Monitoring, Land Use Controls, Continued Operation of the SVE Containment System, and Enhanced Soil Vapor Extraction at Site 1

This alternative would include the continued operation of the SVE Containment System as described in Alternative SV-2, plus the installation of additional SVE wells at Site 1 to target soil vapor near the potential residual reservoirs of the VOCs. Targeting the removal of VOCs near the source would decrease the time required for the system to operate. This alternative assumes that up to six additional SVE wells would be installed in the source area (Figure 5-9). As with Alternative SV-2, LUCs would be used to provide notice of residual VOC contamination and the need to take appropriate actions to control the potential for vapor intrusion and a monitoring program consisting of monitoring of SVE wells and SVPMs (off-property piezometers).

<u>Development</u>

Alternative SV-3 would address the potential for vapor intrusion by monitoring, LUCs, and supplementing the existing SVE Containment System. Monitoring would include sampling of already present off-property piezometers (11 off-property in total, 2001-2011), quarterly sampling of SVE wells (as part of the existing SVE Containment System, 17 in total), quarterly sampling for soil vapor pressure monitors (13 SVPMs), monthly air sampling for regulatory compliance, and maintenance and O&M for the existing SVE Containment System. O&M activities include system maintenance and potential replacement of GAC treatment. Additionally, up to six additional SVE wells would be installed in the source area. SVE wells would be constructed similarly to the existing deep SVE wells. Soil vapor extraction would remove COCs adsorbed to soils in the unsaturated (vadose) zone. Vapors extracted from the subsurface would be treated by GAC as needed to comply with state air discharge standards.

The existing blowers are flow limited to approximately 400 CFM, whereas the conveyance piping, moisture knockout drum and GAC are designed to handle up to 1,000 CFM. Assuming 6 new wells, each operating at 50 CFM, a new 300 CFM blower (or increase in size of the existing blower) would be required (Appendix B).

Detailed Analysis of Alternative

Overall Protection of Human Health and the Environment:

Alternative SV-3 would be protective of human health and the environment because exposure to contaminated vapors would be controlled by maintaining a vacuum barrier in the soil between Site 1 and the residential neighborhood. Operating additional source area wells would decrease the time that the system needs to operate. Monitoring would continue to be conducted to ensure that the SVE Containment System remains protective. LUCs would be used to provide notice of residual VOC contamination and the need to take appropriate actions to control the potential for vapor intrusion.

Compliance with ARARs:

This alternative would comply with chemical-specific ARARs for NYSDOH Air Guideline Values [NYSDOH Soil Vapor Intrusion Guidance (2006), Table 3.1 Indoor Air and Table 3.3 Subslab Vapor (Matrix 1 and 2)] and NYSDOH Air Toxics Control Program (6 NYCRR Part 212 DAR-1 AGC/SGC Tables), and action-specific ARARs for the control and prevention of air pollutants (6 NYCRR 212.9).

Long-term Effectiveness and Permanence:

Alternative SV-3 would be effective in the long term. Contaminated vapors would be contained by the existing SVE Containment System to prevent migration of VOCs into surrounding buildings or neighborhoods. Eventually, VOCs in soil vapor in the source area would decrease to the point that the potential for vapor intrusion would no longer be present. At that time, the SVE Containment System and additional wells could be shut down.

Reduction of Toxicity, Mobility, and Volume through Treatment:

Alternative SV-3 reduces the volume of contaminated soil vapor by extracting it and treating it via GAC, prior to discharge to the atmosphere. The GAC would be taken off site for landfilling or regeneration, during which VOCs would be permanently destroyed. Any residual VOCs discharged to the air would be destroyed through photochemical oxidation. The SVE Containment System removes approximately 12 pounds per year of TCE and PCE (see Appendix B). The use of additional SVE wells within Site 1 would be expected to increase the removal rate initially.

Short-term Effectiveness:

For Alternative SV-3, activities would consist of administrative actions, a vapor monitoring program including sampling of existing SVE wells and monitoring of off-property piezometers and SVPMs. LUCs would prevent exposure to contaminated vapors while COCs attenuate. This alternative would provide for O&M of the existing SVE Containment System, which would protect against migration of contaminated vapors while source area depletion occurs. The time required for the soil vapors to cleanup to the point that the Containment System can be shut down is uncertain, especially when the effects of the soil remedies are considered, but may be completed within 10 to 20 years. The soil remedies would be expected to reduce the time required to operate.

Implementability:

Vendors and equipment are readily available to construct new wells, and maintain, operate and monitor the system. Currently, the SVE Containment System treats vapors contaminated with TCE and PCE with granular activated carbon. Operation, maintenance, and monitoring requirements would continue.

Cost:

The estimated costs associated with Alternative SV-3 are as follows.

Capital Cost: $220,000

O&M: $110,000 per year, over 15 years (O&M)

$15,000 every five years, over 30 years (Five-Year Review and LUCs, incremental to the Soil Five-Year Review and LUCs)

Present Value: $1,700,000 (15 years)

5.2.11 Alternative G-2 – Monitoring and Land Use Controls

This alternative consists of monitoring and LUCs for groundwater COCs consisting of PCBs, arsenic, hexavalent chromium, and total chromium. These LUCs would be in addition to the current restrictions for VOCs in groundwater. Monitoring would be conducted to track the migration and attenuation of the COCs over time. The LUCs would be used to control exposure to impacted groundwater. At the same time, the concentration of these COCs in groundwater will decrease through attenuation processes described below.

Development

The monitoring well network for Alternative G-2 would consist of approximately 28 groundwater monitoring wells, including an assumed 4 new monitoring wells to be installed (Figure 5-10). Groundwater samples would be taken annually until cleanup levels are achieved. The samples would be analyzed for metals and PCBs. During the monitoring program, optimization activities to modify the number of wells and analytes would be conducted. The number of wells and analytes would be finalized in a post-ROD remedial design.

LUCs would be used to prevent exposure to site COCs until the PRGs are achieved. The LUCs would consist of limiting the installation of groundwater extraction wells and/or the use of contaminated groundwater. Groundwater monitoring would be conducted to evaluate groundwater migration and the potential effects of soil remediation on groundwater, and the potential need to take additional actions (see Alternatives G-3A and G-3B).

The source(s) of the PCBs and metals in groundwater is anticipated to be depleted over time. Active remedies at Site 1 would be expected to decrease or eliminate a continuing source of groundwater contamination in a shorter period of time. These actions will decrease the loading of COCs to groundwater. Once in groundwater, the metals would be removed by adsorption onto soil particles, chemical reduction of hexavalent chromium to a more stable from, and precipitation. Although PCBs do not readily degrade, they are subject to removal from groundwater via adsorption onto stationary soil particles, and filtration of mobile colloidal particulates into the sandy media.

<u>Detailed Analysis of Alternative</u>

Overall Protection of Human Health and the Environment:

Alternative G-2 is expected to be protective of human health and the environment. Under current conditions, access to contaminated groundwater is either restricted (protected by a natural barriers of 50 feet of soil) or intercepted by the ONCT system. Monitoring would be used to track COC migration and attenuation, and if necessary, identify the need for additional action (e.g., Alternatives G-3A and G-3B). LUCs would be used to provide notice and restrict the use of contaminated groundwater for potable water applications until cleanup levels are met. Currently, the ONCT system treats VOCs in groundwater via air stripping. If PCBs or metals migrate to the ONCT system at concentrations above discharge standards, the system would be shut down under supplemental treatment technologies are implemented.

Compliance with ARARs:

Alternative G-2 would eventually comply with the chemical-specific ARAR, NYSDOH MCLs for drinking water (equivalent to USEPA Safe Drinking Water Act MCLs) (10 NYCRR Part 5-1: 5-1.52), state regulations for a sole-source drinking water aquifer (6 NYCRR Parts 701.15 and 702.3) and groundwater quality standards (6 NYCRR 703.5, Table 1), and location-specific ARAR for the Safe Drinking Water Act sole-source drinking water aquifer (40 C.F.R. 149.3). However, based on the persistence of some of the chemicals, the time required to achieve ARARs would likely exceed 30 years.

Long-term Effectiveness and Permanence:

Alternative G-2 would be effective in the long term. Monitoring would be used to track migration and attenuation of COCs and LUCs would be used to restrict or provide notice of residual groundwater contamination.

Reduction of Toxicity, Mobility and Volume through Treatment:

There would be no reduction of toxicity, mobility, or volume through treatment under this alternative. Residual groundwater contamination would decrease in concentration through natural mechanisms, such as adsorption, filtration for PCBs, and precipitation, adsorption, filtration, and chemical reduction for metals. Low-volume, non-hazardous purge water would be generated during implementation of this remedy.

Short-term Effectiveness:

For Alternative G-2, activities are limited to administrative actions and groundwater monitoring activities; therefore there would be no significant risk to human health or the environment during implementation of this alternative. Compliance with the RAOs would initially be achieved upon implementation of the LUCs and ultimately through attenuation processes. Potential exposure to contaminated groundwater could occur during sampling, but exposure would be controlled by wearing appropriate PPE. Although no actions are being taken to accelerate cleanup of groundwater in Alternative G-2, cleanup levels would ultimately be achieved, although the time of compliance is uncertain, and would in part depend on other actions taken at Site 1.

Implementability:

LUCs and monitoring are technically feasible and could be implemented within one year after signing of the ROD.

Cost:

The estimated costs associated with Alternative G-2 are as follows.

Capital Cost: $230,000

O&M: $96,000 per year, over 30 years (O&M)

$15,000 every five years, over 30 years (Five-Year Review and LUCs, incremental to the Soil Five-Year Review and LUCs)

Present Value: $2,600,000 (30 years)

5.2.12 Alternatives G-3A and G-3B – Upgrade of the ONCT System with GAC Treatment (G-3A, PCBs) or Ion Exchange Treatment (G-3B, Hexavalent Chromium)

Alternatives G-3A and G-3B include the same monitoring and LUCs as Alternative G-2, but also include provisions for adding treatment for metals and PCBs to the existing ONCT System (Figure 5-11). Both alternatives are based on NG continuing to operate the ONCT for VOC treatment. Alternative G-3A assumes that PCBs would enter the ONCT System at concentrations that would require treatment in accordance with the SPDES permit prior to discharge. For this FS, liquid phase granular activated carbon (GAC) would be used. Alternative G-3B is similar to Alternative G-3A, except it assumes that arsenic, chromium, or hexavalent chromium enters the treatment system and that ion exchange would be used to treat for the metals. These alternatives were developed to ensure that the ONCT system can comply with discharge permits and continue operation if migration of PCBs or metals in groundwater occurs.

<u>Development</u>

The development of monitoring and LUCs for Alternatives G-3A and G-3B would be the same as described under Alternative G-2.

For Alternative 3A, the system design flow rate of 3,800 gallons per minute or 2 billion gallons per year is used. PCB removal would be accomplished via GAC adsorption. Based on typical GAC units rated at 700 gpm each, approximately six (6) 20,000 pound vessels would be required for the two treatment plants in the ONCT. Because PCBs are readily adsorbed onto GAC, the maximum groundwater PCB concentration of 8.2 µg/L was used. Using an estimated specific throughput of 750,000 gallons per pound of GAC, approximately 2,700 pounds of GAC per year would be required to treat the PCBs.

For Alternative G-3B, two 1,700 gpm units would be used to remove hexavalent chromium from the water. Based on the effluent limit to be achieved, a portion of the water would be treated in these units and then blended with untreated water. Assuming an average influent concentration of hexavalent chromium of 182 µg/L (BPS1-TT-MW304I2-01182012D), an effluent treatment concentration of 10 µg/L, and a discharge limit of 50 µg/L, approximately 77 percent of the water would be treated or 2,900 gpm.

Detailed Analysis of Alternatives

Overall Protection of Human Health and the Environment:

Alternatives G-3A and G-3B are expected to be protective of human health and the environment. Under current conditions, access to contaminated groundwater is either restricted (protected by a natural barriers of 50 feet of soil) or intercepted by the ONCT system. Monitoring would be used to track COC migration and attenuation, and if necessary, identify the need for additional action (e.g. Alternatives G-3A and G-3B). LUCs would be used to provide notice and restrict the use of contaminated groundwater for potable water applications until cleanup levels are met.

Currently, the ONCT system treats VOCs in groundwater via air stripping. If PCBs or metals are determined to have migrated to the ONCT system influent and require treatment, the ONCT system would be upgraded to address PCBs (Alternative G-3A) and/or metals (Alternative G-3B).

Compliance with ARARs:

Alternatives G-3A and G-3B would eventually comply with the chemical-specific ARAR, NYSDOH MCLs for drinking water (equivalent to USEPA Safe Drinking Water Act MCLs) (10 NYCRR Part 5-1: 5-1.52), state regulations for a sole-source drinking water aquifer (6 NYCRR Parts 701.15 and 702.3) and groundwater quality standards (6 NYCRR 703.5, Table 1), and location-specific ARAR for the Safe Drinking Water Act sole-source drinking water aquifer (40 C.F.R. 149.3).

Long-term Effectiveness and Permanence:

Alternatives G-3A and G-3B would be effective in the long term. Monitoring would be used to track migration and attenuation of COCs and LUCs would be used to restrict or provide notice of residual groundwater contamination. If needed, upgrades to the ONCT system would be implemented to be protective and comply with applicable discharge permits.

Reduction of Toxicity, Mobility and Volume through Treatment:

PCBs and metals would be treated under Alternatives 3A and 3B, respectively. The PCBs would be adsorbed onto GAC. The GAC would then be treated offsite and the PCBs permanently destroyed via thermal oxidation or landfilled, in which case the PCBs would not be treated. The metals would be adsorbed onto resin. The resin would then be regenerated and the metals concentrated for subsequent chemical reduction (hexavalent chromium) and precipitation or landfilled. Assuming 8.3 µg/L of PCBs in the ONCT system influent, at the design flow rate, approximately 140 pounds per year of PCBs would be removed from groundwater. For hexavalent chromium, assuming an influent concentration of 182 µg/L and an effluent concentration of 50 µg/L, approximately 2,200 pounds per year of chromium would be removed and lesser quantities of other metals. Low-volume, non-hazardous purge water would be generated during implementation of monitoring in this remedy.

Short-term Effectiveness:

For Alternatives G-3A and G-3B, activities consist of treatment plant upgrades, operation, and groundwater monitoring activities. There would be no significant risk to human health or the environment during implementation of this alternative. Compliance with the RAOs would initially be achieved upon implementation of the LUCs and ultimately through attenuation processes. Potential exposure to contaminated groundwater could occur during treatment and sampling, but exposure would be controlled by wearing appropriate PPE. Although no actions are being taken to accelerate cleanup of groundwater in Alternatives G-3A and G-3B, cleanup levels would ultimately be achieved, although the time of compliance is uncertain, and would in part depend on other actions taken at Site 1.

Implementability:

LUCs and monitoring are technically feasible and could be implemented after signing of the ROD. Vendors and equipment are available for both upgrades to the ONCT system. The majority of the infrastructure is already in place.

Cost:

The estimated costs associated with Alternatives G-3A and G-3B are as follows.

<u>Alternative 3A</u>

Capital Cost: $3,100,000

O&M: $153,000 per year, over 30 years (O&M)
$15,000 every five years, over 30 years (Five-Year Review and LUCs, incremental to the Soil Five-Year Review and LUCs)

Present Value: $6,900,000 (30 years)

<u>Alternative 3B</u>

Capital Cost: $2,200,000

O&M: $550,000 per year, over 30 years (O&M)
$15,000 every five years, over 30 years (Five-Year Review and LUCs, incremental to the Soil Five-Year Review and LUCs)

Present Value: $15,800,000 (30 years)

5.3 COMPARATIVE ANALYSIS OF SOIL ALTERNATIVES

This section provides a comparative analysis of the soil remedial alternatives. The criteria for comparison are identical to those used for the detailed analysis of the individual alternatives. A comparative analysis of soil alternatives is summarized in Table 5-2.

5.3.1 Overall Protection of Human Health and the Environment

Alternative S-1 is not protective of human health and the environment, and would not achieve site-specific remedial action objectives. Soil COCs provide a direct contact risk, and soil COC could still migrate to groundwater and soil vapor.

In the long term, Alternatives S-2, S-3, S-4, S-5A, S-5B, S-6, and S-7 would achieve the RAOs. Alternative S-7 achieves each of the RAOs through excavation and offsite disposal, whereas the other alternatives achieve the RAOs through remedial actions, including containment and treatment.

The remedial actions associated with each of the alternatives focus on the PCBs because they are present throughout much of Site 1, represent the majority of the COC mass present, are persistent in the environment, and are present in groundwater. The pesticide, VOC, and SVOC COCs were detected infrequently and sporadically throughout the site and are subject to degradation through natural mechanisms. The action-alternatives address these COCs through containment and natural degradation. The metals are also present infrequently and sporadically throughout the site, but generally do not degrade. One of the metals, hexavalent chromium can degrade to a more stable and less toxic and mobile trivalent chromium. The alternatives address the metals through containment.

Alternatives S-2 through S-6 would prevent human exposure to contaminated soil and erosion of contaminated soil to surface water and sediment via containment and LUCs. For Alternatives S-2 and S-6, the containment is a permeable cover, whereas for Alternatives S-3 through S-5B, an impermeable – RCRA cap would be used.

Each of the alternatives provides a reduction of COC migration to groundwater. Alternatives S-2 to through S-5B use an impermeable cap to effectively eliminate migration of COCs from unsaturated soil to groundwater. Alternatives S-5A (using solidification) and S-5B (using solvent extraction) would further reduce migration of COCs from unsaturated soil to groundwater and from saturated soil to groundwater through treatment. Alternatives S-4 and S-5B would use vertical barriers to limit migration of COC-impacted groundwater. Alternatives S-6 and S-7 would reduce COC migration by excavation and offsite disposal of the majority or all of the COC-impacted soil, respectively.

5.3.2 Compliance with ARARs

Alternative S-1 would not comply with ARARs. Soils contain PCBs greater than New York State Soil Cleanup Objectives (10 NYCRR Part 375) and there would be no action taken to isolate them from human contact or the environment. In addition, these soils would continue to leach and result in groundwater with PCBs greater than New York State Public Water Supply Regulations (10 NYCRR Part 5-1) and the New York State Water Classification and Quality Standards (6 NYCRR 701 and 702).

Alternatives S-2, S-3, S-6, and S-7 would comply with the chemical-specific ARAR for soil (NYSDEC SCO for Commercial Use, 10 NYCRR Part 375-6b), the location-specific ARAR for management of a contaminated site (6 NYCRR 375 Parts 1.1 to 1.12), and the action-specific ARAR for characterization and identification of wastes (6 NYCRR 371.3, 372.2, and 373-1.1).

Alternatives S-4, S-5A and S-5B would also comply with action-specific ARARs for federal requirements for Underground Injection Control (40 C.F.R. 144.81 and 0.82). Additionally, because of the use of a solvent, Alternative S-5B would comply with action-specific ARARs for federal and State requirements for management of fuels and oil (40 C.F.R. 112.3-.6 and 6 NYCRR Parts 615.8 – 0.14).

5.3.3 Long-term Effectiveness and Permanence

Alternative S-1 is not effective in the long-term. People could be exposed to contaminated soil via direct contact. Contaminated soil would also continue to leach to groundwater and erode to surface water and sediment in the recharge basins. In addition, VOCs in soil would continue to impact soil vapor and result in vapor intrusion issues for an extended period of time.

Alternatives S-2, S-3, S-4, S-5A, S-5B, and S-6 would be effective and reliable in the long term because of the containment of contaminated soil and LUCs that would reduce or eliminate potential exposure to COCs and migration of COCs to groundwater. Alternative S-2 provides the least reduction in potential COC migration to groundwater. Alternatives S-3 and S-4 are more protective then Alternative S-2, because of the use of impermeable barriers to further limit COC migration from soil to groundwater. Alternatives S-5A and S-5B are more protective than Alternatives S-2 through S-4 by the use of treatment to immobilize the PCBs and other COCs (Alternative S-5A) and solvent extraction (Alternative S-5B) to remove PCBs and other COCs from soil. Alternatives S-6 and S-7 provide additional protection, because the majority or all of the PCBs and other COCs are removed from the site, respectively.

Alternatives S-2, S-3, and S-4, would leave PCB-contaminated soil at concentrations over 1,000 mg/kg, but generally at depths greater than 10 feet bgs. Under Alternative S-5A, similar concentrations would remain, but soil with PCBs greater than 50 mg/kg would be solidified to immobilize the PCBs. Under Alternative S-5B, soil with PCBs greater than 50 mg/kg would be treated with solvent extraction to remove approximately 88 percent of the COC mass. Under Alternatives S-6 and S-7, soil with PCBs greater than 10 mg/kg and 1 mg/kg, respectively, would be excavated and disposed off site.

5.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

There would be no reduction of toxicity, mobility, or volume through treatment with Alternatives S-1, S-2, S-3, S-4, S-6, or S-7. Under Alternative S-5A, approximately 3,300 pounds of PCBs in 16,000 cubic yards of soil would be treated with in-situ solidification. Under Alternative S-5B, approximately 4,200 pounds of PCBs would be removed from approximately 76,000 cubic yards of soil via solvent extraction and then thermally or chemically treated to permanently destroy the PCBs.

In addition, Alternatives S-2, S-3, S-4, S5A, and S5B would excavate and dispose offsite 1,100 to 1,400 pounds of PCBs in 7,200 to 14,500 cubic yards of soil. Alternatives S-6 and S-7 would excavate and dispose offsite 6,400 pounds of PCBs in 73,000 cubic yards of soil and 7,500 pounds of PCBs in 144,000 cubic yards of soil, respectively.

5.3.5 Short-Term Effectiveness

Alternative S-1 is not effective in the short-term. Contaminated soils will remain, local receptors could be exposed to contaminated soil, and COC leaching to groundwater would continue. Alternatives S-2 through S-7 would be effective in the short term. Each of these remedial alternatives poses some risk to site workers (contact with contaminated media) with equipment use and contact with COCs. The potential risk to workers is proportional to the level of effort conducted. Safe work practices and PPE would be used to protect site workers during implementation of the activities.

The time required to implement each alternative is dependent on the level of effort to be conducted. Alternative S-2 could be implemented within 5 years after signing of the ROD. Alternatives S-3 and S-4, which are containment alternatives, could be implemented within 6 to 7 years after signed of the ROD. Alternatives S-5A and S-5B, which are treatment alternatives, would be expected to require 8 years to 11 years to implement. Alternatives S-6 and S-7, which involve extensive excavation and offsite disposal, would require 7 to 10 years to implement.

5.3.6 Implementability

Each of the alternatives are implementable. Since there is no action, Alternative S-1 requires no activities to implement. Alternatives S-2, S-3, and S-4 that use conventional excavation above the water table, offsite disposal, and covering/capping are moderately easy to implement. Alternatives S-6 and S-7 that involve excavation below the water table would be more difficult to implement. Alternative S-5A that involves treatment would be moderately difficult to implement, whereas Alternative S-5B that involves an innovative technology may be difficult to implement.

Multiple venders, equipment, and offsite landfills are available for the excavation, capping, transportation, and disposal aspects of each of the alternatives. Vendors and equipment are available for installation of a vertical barrier or solidification; however, specialized equipment would be required for solidification of soils to a depth of 65 feet bgs. The availability of vendors to conduct the solvent/air sparging system is very limited. Site 1 is located in an area of industrial and residential development that would prevent horizontal development.

5.3.7 Cost

There are no costs associated with Alternative S-1. Alternative S-7 is the most expensive to implement. A full summary of costs associated with the alternatives is provided in Table 5-2. Detailed costs analyses are provided in Appendix C.

5.4 COMPARATIVE ANALYSIS OF SOIL VAPOR ALTERNATIVES

This section compares the analyses that were presented for each of the soil vapor alternatives. The criteria for comparison are identical to those used for the detailed analysis of the individual alternatives. A comparative analysis of alternatives is summarized in Table 5-3.

5.4.1 Overall Protection of Human Health and the Environment

Alternative SV-1 is not protective of human health and the environment, and would not meet RAO because no actions would be taken to eliminate risks from remaining contamination. The SVE Containment System was installed as an interim remedial action. Under Alternative SV-1, this system would be shut down, and contaminated vapors could again migrate off property and impact residential housing.

Alternatives SV-2 and SV-3 are expected to be protective of human health and the environment because the direct contact risk (exposure to contaminated vapors) would be mitigated via continued operation of the SVE Containment System. LUCs would be in place while contamination remains. Additional treatment under Alternative SV-3 would shorten the duration of operation of the SVE Containment System.

5.4.2 Compliance with ARARs

Alternative SV-1 would not comply with ARARs.

Alternatives SV-2 and SV-3 would comply with chemical-specific ARARs for NYSDOH Air Guideline Values [NYSDOH Soil Vapor Intrusion Guidance (2006), Table 3.1 Indoor Air and Table 3.3 Subslab Vapor (Matrix 1 and 2)] and NYSDOH Air Toxics Control Program (6 NYCRR Part 212 DAR-1 AGC/SGC Tables), and action-specific ARARs for the control and prevention of air pollutants (6 NYCRR 212.9).

5.4.3 Long-term Effectiveness and Permanence

Alternative SV-1 is not effective in the long-term. Soils contaminated with VOCs could take an extended period of time to attenuate, providing a continuing source of contaminated vapors. Alternatives SV-2 and SV-3 would be effective in the long term. Contaminated vapors would be contained by the existing SVE Containment System to prevent migration of VOCs into surrounding buildings or neighborhoods.

5.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

There would be no reduction of toxicity, mobility, or volume through treatment with Alternative SV-1.

Alternatives SV-2 and SV-3 would reduce the toxicity by removing VOC-contaminated soil gas and treating it with GAC. The current mass loading of TCE and PCE is approximately 12 pounds per year (SV-2). Under Alternative SV-3, the loading of VOCs would be expected to increase initially, but over the long term, the total mass of VOCs removed under Alternative SV-3 is expected to be similar to SV-2.

5.4.5 Short-Term Effectiveness

Alternative SV-1 is not effective in the short term. The SVE Containment System would no longer operate, and contaminated vapors could migrate to the nearby neighborhood unmitigated.

Alternatives SV-2 and SV-3 would provide for continued operation of the existing SVE Containment System, which would effectively control COC migration. Ultimately the SVE Containment System could be shutdown, although the timing is uncertain. Since Alternative SV-3 provides treatment at the source of the VOCs, it would be expected to operate for a shorter period of time (e.g., 15 years) than Alternative SV-2 (e.g., 30 years). LUCs would be in place while COCs at concentrations greater than PRGs remain.

5.4.6 Implementability

Each of the alternatives is implementable. Alternatives SV-1 and SV-2 can be easily implemented, with resources readily available for a monitoring program under Alternative SV-2. The infrastructure for the SVE Containment System is already in place; therefore, additional actions would consist of continued operation and maintenance activities. Alternative SV-3 would require the installation of additional wells. Vendors and equipment are readily available to conduct this work.

5.4.7 Cost

There are no costs associated with implementing Alternative SV-1. Alternative SV-3 is the most expensive to implement, with the addition of source area treatment. A full summary of costs associated with the alternatives is provided in Table 5-3. Detailed cost analyses are provide in Appendix C.

5.5 COMPARATIVE ANALYSIS OF GROUNDWATER ALTERNATIVES

This section compares the analyses that were presented for each of the groundwater remedial alternatives. The criteria for comparison are identical to those used for the detailed analysis of the individual alternatives. A comparative analysis is summarized in Table 5-4.

5.5.1 Overall Protection of Human Health and the Environment

Alternative G-1 is not protective of human health and the environment, and would not meet the RAOs because no actions would be taken to eliminate risks from remaining contamination. An interim remedial action has already been conducted to provide treatment for VOCs in groundwater (ONCT system), however, it would not address metals and PCBs.

Alternative G-2 may be protective of human health and the environment. While groundwater will be monitored for COCs, treated for VOCs, and LUCs would be in place to be protective while contamination remains, groundwater contaminated with PCBs and metals could still continue to migrate and may impact the ONCT system. If the PCB or metal concentrations exceed discharge standards for in the ONCT System (e.g., MCLs), it would need to be shut down or upgraded to be compliant with a discharge permit.

Alternatives G-3A and G-3B would be protective of human health and the environment. If groundwater monitoring shows that PCB- or metal-contaminated groundwater has migrated to the ONCT system, the system would be upgraded to provide treatment to be protective.

5.5.2 Compliance with ARARs

Alternative G-1 would not comply with the chemical-specific ARARs for state or federal criteria.

Alternatives G-2, G-3A and G-3B would comply with the chemical-specific ARAR, NYSDOH MCLs for drinking water (equivalent to USEPA Safe Drinking Water Act MCLs) (10 NYCRR Part 5-1: 5-1.52), state regulations for a sole-source drinking water aquifer (6 NYCRR Parts 701.15 and 702.3) and location-specific ARAR for the Safe Drinking Water Act sole-source drinking water aquifer (40 C.F.R. 149.).

5.5.3 Long-term Effectiveness and Permanence

Alternative G-1 is not effective in the long-term. Contaminated groundwater would take an extended time period to attenuate, especially for COCs such as PCBs. VOCs, metals, and PCBs in groundwater exceed PRGs and pose a risk to human health. There would be no controls in place to monitor groundwater use or migration of contaminated groundwater.

Alternatives G-2, G-3A, and G-3B would be effective in the long term. At completion of the remedy, site COCs would be below PRGs, which are based on requirements for a sole-source drinking water aquifer.

5.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

There would be no reduction of toxicity, mobility, or volume through treatment with Alternatives G-1 or G-2. Residual groundwater contamination would degrade through natural attenuation processes including adsorption, precipitation, and for hexavalent chromium, chemical reduction.

Alternatives G-3A and G-3B would provide treatment of either PCBs or metals (e.g., hexavalent chromium) in groundwater, respectively. GAC and ion exchange resin would be taken off site for regeneration, treatment, or disposal. Low-volume, non-hazardous purge water would be generated during implementation of monitoring in this remedy, or in association with groundwater monitoring conducted under Alternatives G-2, G-3A and G-3B.

5.5.5 Short-Term Effectiveness

Alternative G-1 would not be effective in the short term. The other alternatives would be effective in the short term. For Alternative G-2, activities are limited to administrative actions and groundwater monitoring activities and there would be no significant risk to human health or the environment during implementation of this alternative. LUCs would be protective while contamination remains. Groundwater contaminated with PCBs or hexavalent chromium could migrate to the ONCT system and cause a shut-down of the system.

Alternatives G-3A and G-3B would be protective in the short-term due to implementation of LUCs and monitoring of migration of contamination. If contaminated groundwater does migrate to the ONCT system, upgrades of the system would be provided for.

5.5.6 Implementability

Each of the alternatives is implementable. Alternatives G-1 and G-2 are easy to implement, with readily available resources for Alternative G-2.

Alternatives G-3A and G-3B are only slightly more difficult to implement. Vendors that provide GAC and ion exchange resin are available. The majority of the infrastructure for the ONCT system is already in place; theses alternatives would only involve an upgrade to the system.

5.5.7 Cost

There are no costs associated with Alternative G-1. Alternatives G-3A and G-3B would be the most expensive to implement with the addition of treatment for metals and/or PCBs. A full summary of costs is provided in Table 5-4. Detailed cost analyses are provided in Appendix C.

5.6 LIFE-CYCLE ANALYSIS AND OPTIMIZATION

Lifecycle analyses were performed using the Navy's Sitewise™ tool for a comparative analysis of alternatives as a Navy requirement. Optimization is commonly conducted throughout the life-cycle of a remedial project, from remedy selection to decommissioning. Periodic optimization and sustainability evaluations throughout the project life-cycle are an effective means of improving remedy effectiveness, controlling life-cycle costs, and reducing the overall environmental footprint, such as greenhouse gas emissions, energy usage, and other resource consumption.

5.6.1 Objective

The Environmental Footprint Evaluation of remedial alternatives is provided in Appendix D. The purpose of the footprint evaluation is to assess the environmental impacts of the twelve remedial alternatives (S-1 through S-7, G-1 through G-3B, and SV-1 through SV-3) using metrics of greenhouse gas (GHG) and criteria pollutant emissions, energy use, water consumption, and worker safety. The results of this footprint evaluation are intended to provide additional information for consideration during remedy selection, design, and to enhance the understanding of the environmental impacts throughout the remedy life-cycle for each of the proposed alternatives.

5.6.2 Sustainability Evaluation Policy Background

DOD and Navy policies require continual optimization of remedies in every phase from remedy selection through the site closeout (NAVFAC, 2010).

In January 2007, Executive Order 13423 set targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, etc. In October 2009, Executive Order 13514 was issued, which reinforced these sustainability requirements and established specific goals for federal agencies to meet by 2020.

In August 2009, DOD issued a policy for “Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program.” The DOD policy and related Navy guidance state that opportunities to increase sustainability should be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout). In response to this policy, the Department of the Navy (DON) issued an updated Navy Guidance for “Optimizing Remedy Evaluation, Selections, and Design” (NAVFAC, 2010), which includes environmental footprint evaluations as part of the traditional DON optimization review process for remedy selection, design, and remedial action operation. In August 2010, NAVFAC issued policy requiring use of the SiteWise™ tool to perform environmental impact reviews as part of all Feasibility Studies and Remedial Action Plans. As such, this environmental footprint evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of reducing the environmental impact of remedial actions as possible at Bethpage Site 1.

Applying the DON optimization concepts with an environmental footprint evaluation within the remedy selection and design phases allows for the following benefits:

- Determining factors in each remedial alternative with the greatest environmental impacts and gathering insight into how to reduce these impacts;
- Evaluating remedial alternatives with optimized or reduced environmental footprints in conjunction with other selection criteria;
- Designing and implementing a more robust remedy while balancing the impact to the environment; and
- Ensuring efficient, cost-effective and sustainable site closeout.

5.6.3 Evaluation Tools

This evaluation was performed using a hybrid model of the Navy's SiteWise™ tool supplemented with a Tetra Tech developed model as appropriate for some site-specific items.

SiteWise™ is a life-cycle footprint assessment tool developed jointly by the U.S. Navy, U.S. Army Corps of Engineers (USACE), and Battelle. SiteWise™ assesses the environmental footprint of a remedial alternative/technology using a consistent set of metrics. The assessment is conducted using a building block approach, where each remedial alternative is first broken down into modules that follow the phases for most remedial actions, including RI, remedial action construction (RA-C), remedial action operation (RA-O), and long-term monitoring (LTM). Once broken down by remedial phase, the footprint of each phase is calculated. The phase-specific footprints are then combined to estimate the overall footprint of the remedial alternative. This building block approach reduces redundancy in the footprint assessment and facilitates the identification of specific impact drivers that contribute to environmental footprint. The inputs that need to be considered include (1) production of material required by the activity; (2) transportation of the required materials to the site, transportation of personnel; (3) all site activities to be performed; and (4) management of the waste produced by the activity.

GSRx builds off of SiteWise™ and allows for a flexible, detailed analysis, particularly for materials and equipment use. GSRx was used to account for materials and activities not readily input into SiteWise™ and where equipment usage assumptions built into SiteWise™ were not consistent with site-specific requirements.

5.6.4 Environmental Footprint Evaluation Framework and Limitations

The environmental footprint evaluation performed for the Site 1 FS consider life-cycle impacts through greenhouse gas emissions (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_20]), sulfur oxides (SO_x), particulate matter (PM_{10} emissions), energy consumption, water usage, and worker safety.

Life cycle impacts were calculated for energy consumption, emissions of GHG (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) and criteria pollutants (nitrogen oxides [NOx], sulfur oxides [SOx], and particulate matter [PM_{10}]), water usage, energy consumption, and worker safety.

Life cycle inventory inputs in SiteWise™ were divided into four categories – 1) materials production; 2) transportation of personnel, materials and equipment; 3) equipment use and miscellaneous; and 4) residual handling and disposal. Cost estimates from the FS and design calculations were used as a basis for inventory quantities and related assumptions. Emission factors, energy consumption, and water usage data were correlated to material quantities, equipment, transportation distances, and installation timeframes in order to calculate life-cycle emissions, energy consumption, water usage, and worker safety. Default SiteWise™ emission, energy usage, water consumption, and worker fatality and accident risk factors were utilized.

Although a hybrid model of GSRx and SiteWise™ was used to streamline inputs within SiteWise™, limitations still exist. For example, materials and usage of construction equipment are included in the input inventory in GSRx to directly evaluate impact drivers within the GSRx output summary, but are evaluated within the "Equipment Use and Miscellaneous" sector in SiteWise™, which does not differentiate between specific materials or equipment. Additionally, GSRx does not include worker safety based on specific equipment usage because GSRx was not developed to evaluate worker safety.

5.6.5 Evaluation Results

The alternatives that were analyzed with SiteWise™ and GSRx include the following:

- Alternative S-1: No Action
- Alternative S-2: Permeable Cover, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), and Land Use Controls
- Alternative S-3: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), and Land Use Controls
- Alternative S-4: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, and Land Use Controls
- Alternative S-5A: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solidification of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls
- Alternative S-5B: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, In-situ Solvent Extraction of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls
- Alternative S-6: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), Soil Cover, and Land Use Controls
- Alternative S-7: Excavation and Offsite Disposal of PCB-contaminated soil (Greater than 1 mg/kg)
- Alternative SV-1: No Action
- Alternative SV-2: Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System
- Alternative SV-3: Soil Vapor Monitoring, Land Use Controls, Continued Operation of the SVE Containment System, and Enhanced Soil Vapor Extraction at Site 1.
- Alternative G-1: No Action
- Alternative G-2: Monitoring and Land Use Controls
- Alternative G-3A: Monitoring, Land Use Controls, and Upgrade of the ONCT System with GAC Treatment
- Alternative G-3B: Monitoring, Land Use Controls, and Upgrade of the ONCT System with Ion Exchange Treatment

The following sections summarize the relative environmental impacts and primary impact drivers for the twelve action alternatives and their respective metrics. The no action alternatives have no emissions. In addition, the attachment (Appendix D) includes the inventory and output sheets that were used for the SiteWise™/GSRx hybrid model. An evaluation of SiteWise™ and GSRx output summary sheets and related figures included in footprint evaluation attachments (Appendix D), provides detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc.). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Appendix D (Table 1).

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Exhibit 1 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the twelve alternatives evaluated and the y-axis represents the GHG emissions in metric ton of CO_2e.

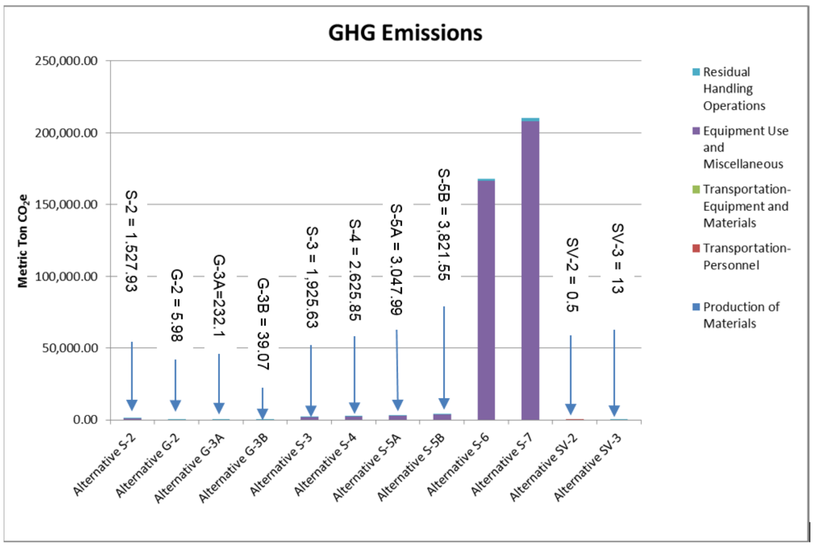

Exhibit 1: GHG Emissions

Criteria Pollutant Emissions - NOx

Exhibit 2 shows the overall NOx emissions of each of the alternatives analyzed; the x-axis represents the twelve alternatives evaluated and the y-axis represents the NOx emissions in metric ton of NOx.

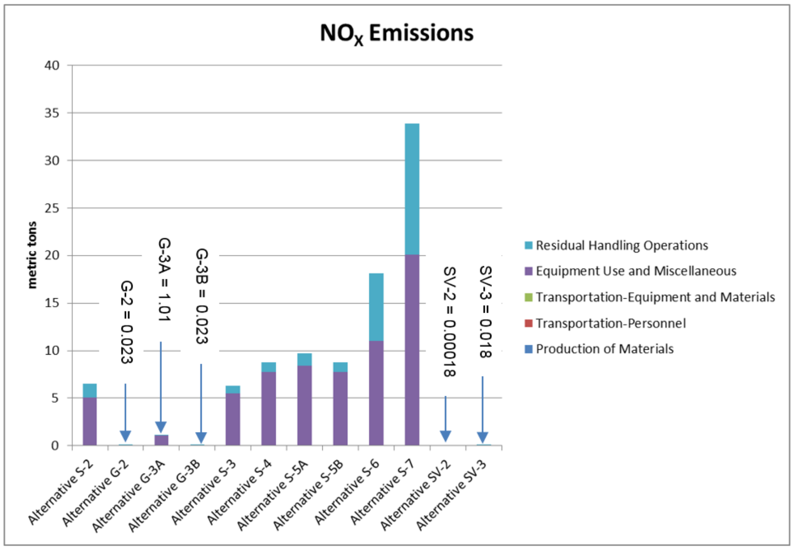

Exhibit 2: NOx Emissions

Criteria Pollutant Emissions - SOx

Exhibit 3 shows the overall SOx emissions of each of the alternatives analyzed; the x-axis represents the twelve alternatives evaluated and the y-axis represents the SOx emissions in metric ton of SOx.

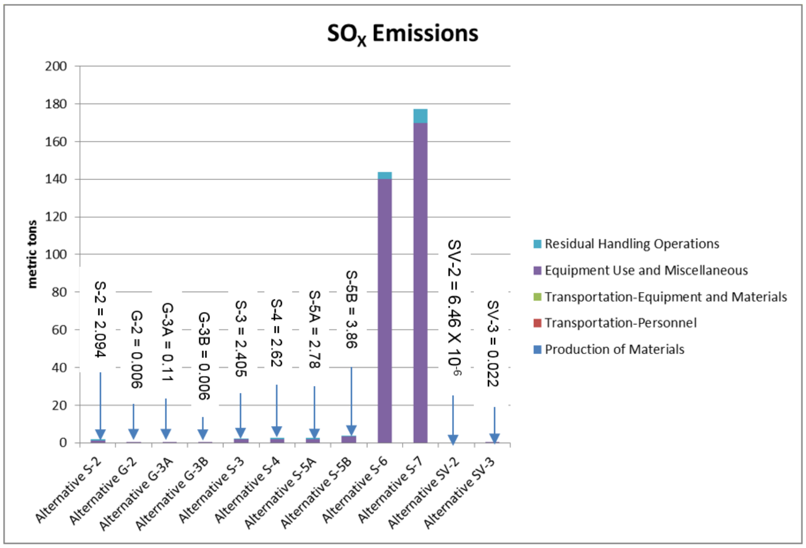

Exhibit 3: SOx Emissions

Criteria Pollutant Emissions – PM_{10}

Exhibit 4 shows the overall PM_{10} emissions of each of the alternatives analyzed; the x-axis represents the twelve alternatives evaluated and the y-axis represents the PM_{10} emissions in metric ton of PM_{10}.

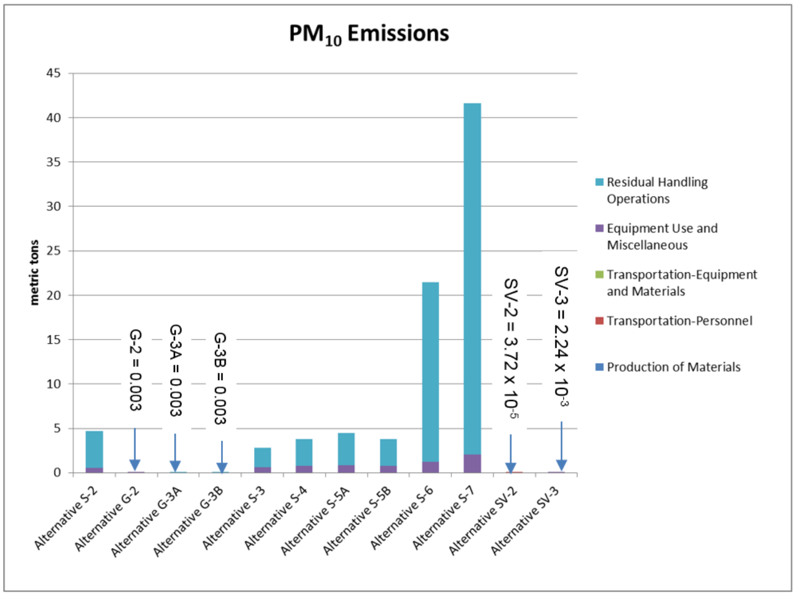

Exhibit 4: PM_{10} Emissions

Energy Consumption

Exhibit 5 shows the energy consumption of each of the alternatives analyzed; the x-axis represents the twelve alternatives evaluated and the y-axis represents the amount of energy consumed in units of million British Thermal Units (MMBTU).

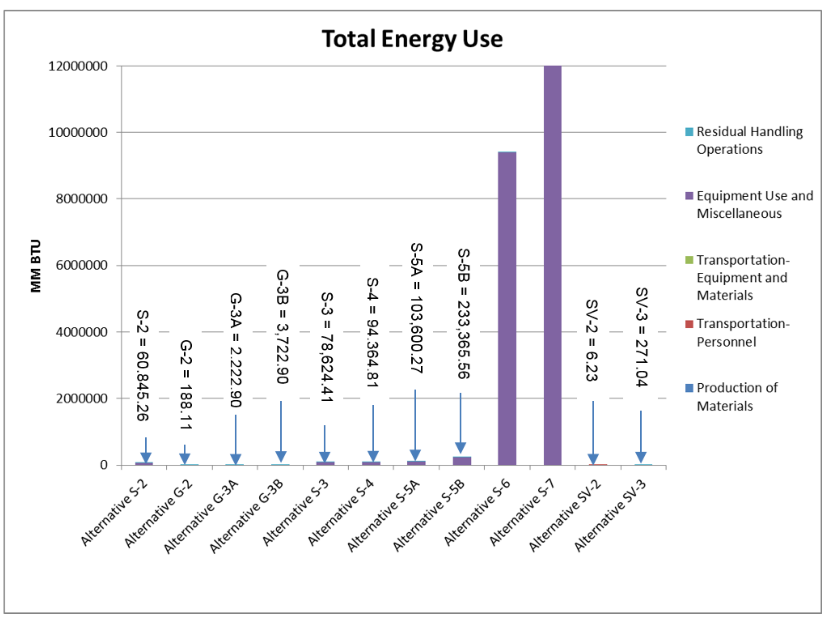

Exhibit 5: Energy Consumption

Water Usage

The water consumption of the evaluated alternatives is shown in Exhibit 6. The x-axis shows the twelve evaluated alternatives, and the y-axis

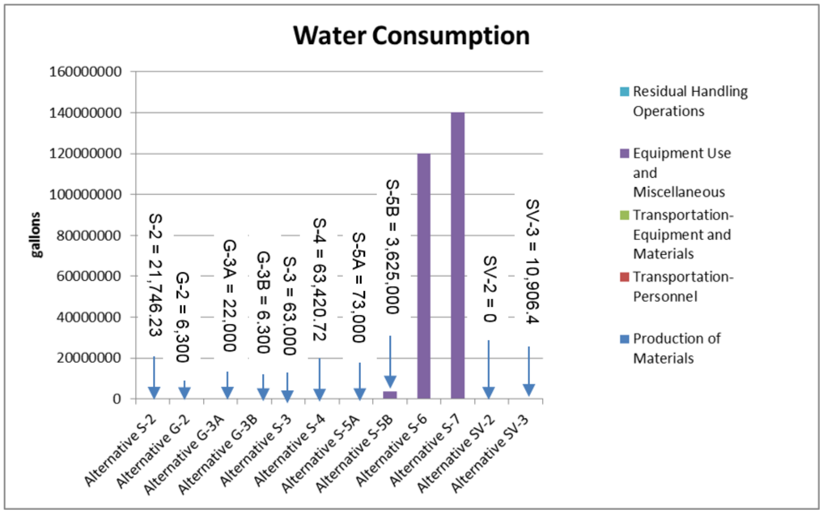

Exhibit 6: Water Consumption

Accident Risk – Fatality

Exhibit 7 shows the risk of fatality between the evaluated alternatives. The x-axis represents the twelve alternatives evaluated, and the y-axis represents the risk of fatality.

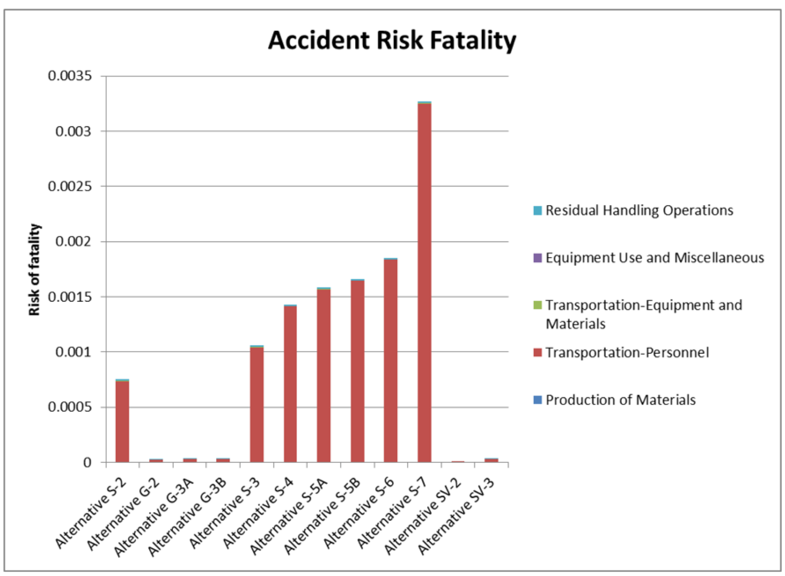

Exhibit 7: Risk of Fatality

Accident Risk – Injury

Exhibit 8 shows the risk of injury between the evaluated alternatives. The x-axis represents the twelve alternatives evaluated, and the y-axis represents the risk of injury.

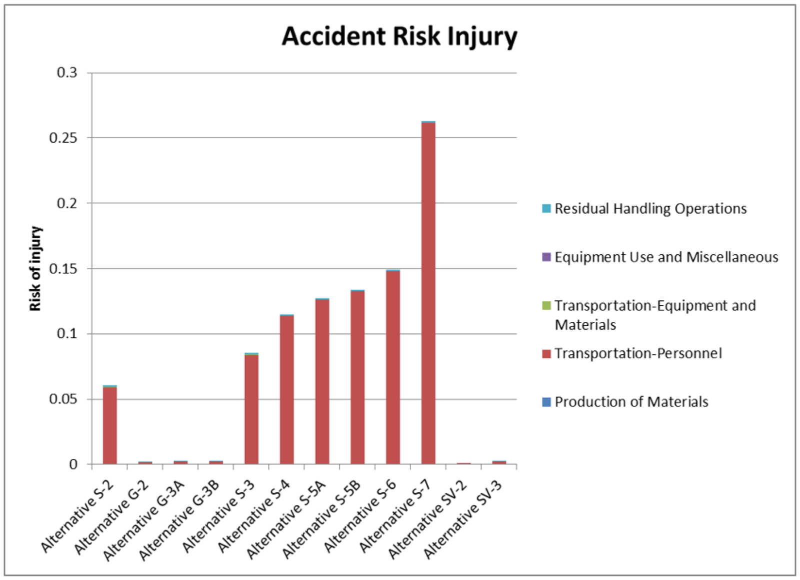

Exhibit 8: Risk of Injury

5.6.6 Conclusions and Recommendations

During selection and design of the remedy, a sensitivity analysis considering elements of the remedy that have the greatest impact on remedy effectiveness, life-cycle cost, and environmental footprint metrics may provide additional insight into appropriate optimization. To aid in the sensitivity analysis, an impact analysis summary was created to qualitatively highlight the relative impact of respective metrics for the twelve alternatives to identify the primary drivers of emissions, energy consumption, and water usage (see Table D-2 in Appendix D for details).

An evaluation was conducted to identify the sector whose contribution is largest to that impact category (Appendix D). Identifying where the large contributions occur optimizes the process for potentially lowering the environmental impacts of each of the alternatives evaluated. Considering this, the following recommendations could noticeably reduce the environmental footprint of the alternatives:

- For all Alternatives: Equipment usage and site activities are the largest contributors to most of the impact categories for all alternatives. It is recommended that the use of necessary equipment be limited as much as possible through clear and concise planning. Overlap of site activities would reduce the overall time of the remedial construction phase, and therefore reduce the total time of equipment use.
- For Alternatives S-2, G-2, G-3A, G-3B, SV-2, and SV-3: Transportation of personnel is a main or secondary contributor that could potentially have a reduced impact if the number of trips to the site and number of people required at the site could be limited.

For all Alternatives: Some reduction of the environmental footprint, particularly GHG emissions and energy consumption, could be realized for all phases through the possible use of emission control measures such as alternate fuel sources (e.g. biodiesel), equipment exhaust controls (e.g. diesel), and equipment idle reduction. This model was run using default values, assuming that these measures were not taking place.

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TABLE 2-1
ANALYTICAL DETECTION SUMMARY OF SITE SOIL SAMPLES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Chemical	Carcinogenic (C) / Non-carcinogenic (N)	Protection of Public Health Commercial Use (mg/kg) (1)	Protection of Public Health Industrial Use (mg/kg) (1)	Restricted Use for the Protection of Groundwater (mg/kg) (1)	Unrestricted Use Soil Cleanup Objectives (mg/kg) (2)	USEPA Regional Screening Levels Residential Soil / Industrial Soil (mg/kg) (3)		1995 Record of Decision (ROD) Preliminary Remediation Goals (PRGs)	Maximum Concentration of Detection (Surface/ Subsurface)		Location and Depth (feet bgs of Maximum Detection (Surface / Subsurface)	Frequency of Detection (Sample Date Range)	Chemical of Concern [Yes (Y) / No (N)]
METALS													
Arsenic	C	16 (4)	16 (4)	16 (4)	13 (4)	0.67	3.0	5.4	55.8 J	150 (11)	BPS1SS106 / BPFWS1SB031-0608	190 / 208 (8/26/1991 - 4/24/2002)	Y (13)
Cadmium	N	9.3	60	7.5	2.5	70	980	--	74.9	3,260	BPAOC30SB13 / BPFWS1SB1004-1012	404 / 603 (8/26/1991 - 4/25/2002)	Y (13)
Chromium, hexavalent	C	400	800 (7)	19	1.0 (9)	0.3	6.3	--	69.5	1,000 (12)	BPFWS1LP048 / BPFWS1LP091-1013	571 / 572 (8/26/1991 - 4/24/2002)	Y (13)
Chromium, trivalent	N	1,500	6,800	--	30 (4)	120,000	1,800,000	--	69.5	1,000 (12)	BPFWS1LP048 / BPFWS1LP091-1013	571 / 572 (8/26/1991 - 4/24/2002)	N
Manganese	N	10,000 (5)	10,000 (5)	2,000	1,600	1,800	26,000	142	180	8,500	BPFWS1SB006 / BPFWS1LP005-1012	175 / 182 (8/26/1991 - 4/24/2002)	Y (13)
PESTICIDES													
Chlordane	C	24	47	2.9	0.094	1.8	8.0	0.206	0.027	0.5	BPS1SB60 / BPS1SB15-0608	8 / 92 (1991 - 1999)	Y (14)
SVOCs													
Benzo(a)anthracene	C	5.6	11	1.0 (4)	1.0 (4)	0.15	2.9	0.33	3.0	3.2	BPS1SB62 / BPS1SB49-0204	10 / 79 (1991 - 1999)	Y (14)
Benzo(a)pyrene	C	1.0 (4)	1.1	22	1.0 (4)	0.015	0.29	0.33	2.7	--	BPS1SB62 / NA	11 / 79 (1991 - 1999)	Y (14)
Benzo(b)fluoranthene	C	5.6	11	1.7	1.0 (4)	0.15	2.9	0.33	3.2	--	BPS1SB62 / NA	11 / 79 (1991 - 1999)	Y (14)
Benzo(k)fluoranthene	C	56	110	1.7	0.8 (4)	1.5	29	0.33	1.1	1.7	BPS1SB62 / BPS1SB27-0608	10 / 79 (1991 - 1999)	Y (14)
Chrysene	C	56	110	1.0 (4)	1.0 (4)	15	290	0.33	3.1	--	BPS1SB62 / NA	10 / 79 (1991 - 1999)	Y (14)
Dibenz(a,h)anthracene	C	0.56	1.1	1,000 (8)	0.33 (9)	0.015	0.29	0.33	3.6 J	--	BPS1SB28 / NA	5 / 79 (1991 - 1999)	Y (14)
Indeno(1,2,3-cd)pyrene	C	5.6	11	8.2	0.5 (4)	0.15	2.9	0.33	4.6	--	BPS1SB28 / NA	18 / 79 (1991 - 1999)	Y (14)
VOCs													
Trichloroethene	C	200	400	0.47	0.47	0.94	6.0	0.01	--	--	NA / NA(16)	6 / 110 (1991 - 1999)	Y (15)
Tetrachloroethene	C	150	300	1.3	1.3	24	100	0.027	--	--	NA / NA(16)	17 / 110 (1991 - 1999)	Y (15)
PCBs	C	1.0	25	3.2	0.1	--	--	1 to 10	3,800 (10)	3,500	BPFWS1SB004 / BPFWS1LP005-0810	82 / 1012 (1991 - 2013)	Y

1 - Soil Screening Objective: New York State Department of Environmental Conservation (NYSDEC) Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for Commercial, Industrial, and for the Protection of Groundwater. DAF = 100, based on a total organic content (TOC) of 1 percent. Non-cancer values (non-carcinogenic) are developed from USEPA and ATSDR reference doses. Cancer values (carcinogenic) are based on a risk value of 1 X 10^{-6}.
2 - Soil Screening Objective: New York State Department of Environmental Conservation (NYSDEC) Part 375 - 6.8(a), Unrestricted Use Soil Cleanup Objectives. DAF = 100, based on a total organic content (TOC) of 1 percent. Non-cancer values (non-carcinogenic) are developed from USEPA and ATSDR reference doses. Cancer values (carcinogenic) are based on a risk value of 1 X 10^{-6}.
3 - United States Environmental Protection Agency (USEPA) Regional Screening Levels - Residential / Industrial. Carcinogenic risks are for a risk value of 1 X 10^{-6}. Non-carcinogenic risks are calculated for a Hazard Index equal to 1. November 2014 values.
4 - If value is less than the rural soil background concentration as determined by the Department of Health rural soil survey, the rural soil background concentration will be used as the soil screening objective value.
5 - This value is capped at a maximum of 10,000 ppm or 10,000 mg/kg.
6 - This value is capped at a maximum of 500 ppm or 500 mg/kg.
7 - The soil screening objective for this compound (or family of compounds) is considered to be met if the analysis for the total species of this contaminant is below the specific soil screening objective.
8 - This value is capped at a maximum of 1,000 parts per million (ppm) or 1,000 mg/kg.
9 - If this value is lower than the Contract Required Quantitation Limit (CRQL), then the CRQL is used.
10 - Note that the maximum exceedance was for Site 1. The maximum concentration of PCBs at Dry Well 20-08 was 45,000 mg/kg (BPDW20SB01-2224; 16 total sample exeedances out of 173 samples) and the maximum concentration at Dry Well 34-07 was 9,400 mg/kg (BPDW3407SB12-2628; 31 total sample exceedances out of 185 samples).
11 - Pre-excavation design sampling could not duplicate the highest detection of arsenic (3,380 mg/kg in BPS1SB119-0305).
12 - Note that samples were taken for total chromium.
13 - Arsenic and manganese were identified as contaminants of concern (COC)s in the 1995 ROD. Cadmium and chromium are identified as COCs because of the detection of relatively high concentrations in soil and waste samples. These metals are generally co-located with PCBs in soil.
14 - SVOCs and pesticides were identified as COCs in the 1995 ROD. Pre-excavation design sampling indicated limited detections of petroleum aromatic hydrocarbons and pesticides. These COCs are generally co-located with the PCBs in soil.
15 - VOCs were identified with the 1995 ROD because of impacts to groundwater, which were addressed by the air sparing/soil vapor extraction system remedial action. VOCs in soils will be considered in this FS to address future vapor intrusion concerns.
16 - VOC detections correspond primarily to samples collected prior to the operation of the air sparging/soil vapor extraction system. VOCs are retained as a COC because of vapor intrusion concerns.

bgs = below ground surface.
PCB = polychlorinated biphenyl.
Carcinogenic = C / Non-carcinogenic = N.
ppm = part per million.
DAF = dilution attenuation factor.
SVOC = semi-volatile organic compound.
VOC = volatile organic compound.
TOC = total organic carbon.
mg/kg = milligram per kilogram.
NA = Not applicable.

TABLE 2-2
POLYCHLORINATED BIPHENYL - MASS AND VOLUME ESTIMATES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Location	Surface Soil or Subsurface Soil PCBs greater than 1 mg/kg		Surface Soil PCBs greater than 1 mg/kg or Subsurface Soil PCBs greater than 10 mg/kg		Surface Soil PCBs greater than 1 mg/kg or Subsurface Soil PCBs greater than 25 mg/kg		Surface Soil PCBs greater than 1 mg/kg or Subsurface Soil PCBs greater than 50 mg/kg	
	Volume of Soil (CY)	Mass of PCBs (pounds)	Volume of Soil (CY)	Mass of PCBs (pounds)	Volume of Soil (CY)	Mass of PCBs (pounds)	Volume of Soil (CY)	Mass of PCBs (pounds)
Site 1 (0 to 2 feet)	14,000	420	14,000	420	14,000	420	14,000	420
Site 1 (greater than 2 feet)	116,000	4,300	66,000	3,300	56,000	2,800	55,000	2,300
DW 20-08	12,800	2,500	12,800	2,400	12,800	2,100	12,800	1,500
DW 34-07	1,200	300	1,200	240	750	190	300	140
Total	144,000	7,520	94,000	6,360	83,550	5,510	82,100	4,360
	144,000	**7,500**	**94,000**	**6,400**	**84,000**	**5,500**	**82,000**	**4,400**

Surface Soil - 0 to 2 feet below ground surface.
PCB - Polychlorinated biphenyl.
DW - Dry Well.
mg/Kg - milligram per kilogram.
CY - cublic yard.

The volume of soil includes horizontal and vertical buffers needed to access soil and includes contingency and are not likely to become larger with additional soil characterization.
The mass of PCBs is based on isoconcentration contours, and actual quantities could be higher or lower.

TABLE 2-3
ANALYTICAL DETECTION SUMMARY OF SITE GROUNDWATER SAMPLES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Chemical	Carcinogenic (C) / Non-carcinogenic (N)	EPA Regional Screening Level (µg/L) [(1)]	EPA Maximum Contaminant Levels (MCLs) (µg/L) [(2)]	NYSDOH MCLs (µg/L) [(3)]	NYSDEC Groundwater Quality Standards (µg/L) [(4)]	Maximum Detected Concentration (µg/L) (Shallow / Intermediate-Depth/ Deep Monitoring Wells)	Location and Well Screen Depth (feet) of Maximum Detection (Shallow/ Intermediate-Depth/ Deep Monitoring Wells)	Frequency of Detection (Sample Date of Maximum Concentration)	Chemical of Concern [Yes (Y) / No (N)]
METALS									
Arsenic	C	0.052	10	10	25	ND / 5.2 / 0.33 J	NA / MW304I1-102112 / MW304D-180190	0/1 / 1/7 (March 2011) / 2/7 (March 2011)	Y [(6)]
Chromium, total	N	--	100 [(5)]	100 [(5)]	50	160 / 182 / 92	MW304I2-102112 / MW304I2-102112 / MW301D-210220	20/20 (January 2012) / 17/17 (January 2012) / 9/9 (January 2012)	Y
Chromium, hexavalent	C	0.035	100 [(5)]	100 [(5)]	50	158 / 200 / N/A	AOC22-MW10-5262 / MW304I2-140150 / N/A	1/20 (November 2012) / 1/17 (January 2012) / N/A	Y [(6)]
Polychlorinated Biphenyls (PCBs)	C	--	0.5	0.5	0.09	24 J / 6.9 / 8.2 J	MW301S-5161 / MW303I1-95105 / MW304D-180190	5/20 (March 2011) / 12/17 (January 2012) / 6/9 (December 2010)	Y

µg/L = microgram per liter. J - estimated value.
NA = Not applicable.
ND = Not detected.

1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels. Values are based on a target carcinogenic risk of 1 X 10^{-6}, or a non-carcinogenic risk for a hazard index equal to 1. November 2014.
2 - EPA Maximum Contaminant Levels (MCLs).
3 - New York State Department of Health (NYSDOH) MCLs. New York Public Supply Regulations, 10 New York Code, Rules, and Regulations (NYCRR) Part 5, Subpart 5-1 Public Water Systems.
4 - New York State Department of Environmental Conservation (NYSDEC) Part 703.5 Table 1 Water Quality Standards Class GA groundwater.
5 - Value is for total chromium.
6 - Elevated risk was identified with arsenic (10^{-4} to 10^{-5}) and hexavalent chromium (>10^{-4}); however, only hexavalent chromium and total chromium exceeded relevant criteria (NYSDOH MCLs). Arsenic is being retained as a risk driver associated with the 2014 Human Health Risk Assessment, but no action is required due to current groundwater concentrations.
Note that volatile organic compounds (VOCs) were noted as Chemicals of Concern (COCs) in the 2003 Operable Unit No. 2 Record of Decision (ROD) and are currently being addressed under that ROD.

TABLE 3-1
CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

MEDIA	REQUIREMENT	DESCRIPTION	PREREQUISITE	CITATION	ARAR DETERMINATION	COMMENT
FEDERAL CHEMICAL-SPECIFIC ARARs						
Groundwater	United States Environmental Protection Agency (USEPA) Maximum Contaminant Limits (MCLs)	These are national primary drinking water regulations that are legally enforceable standards that apply to public water systems.	Standards are used to protect the public health or welfare and enhance water quality.	USEPA National Primary Drinking Water Regulations (NPDWRs) 40 Code of Federal Regulations (CFR) 141.61	Relevant and Appropriate	Standards are used during the selection of groundwater remediation goals.
Soil	Toxic Substances Control Act (TSCA)	Provides testing requirements and restrictions relating to chemical substances and/or mixtures. TSCA addresses the production, importation, use, and disposal of polychlorinated biphenyls (PCBs), asbestos, radon, and lead-based paint.	Soils contaminated with PCBs would meet these disposal and remediation requirements.	40 CFR 761.61(c)	Relevant and Appropriate	Would be an used for cleanups involving PCBs.
NEW YORK STATE CHEMICAL-SPECIFIC ARARs						
Groundwater	New York Water Classifications and Quality Standards	Standards to be considered for actions involving the discharge to groundwater and selection of groundwater plume remediation goals.	Standards are used to protect the public health or welfare and enhance water quality.	6 New York Codes, Rules, and Regulations (NYCRR) Parts 701.15 and 702.3	Relevant and Appropriate	Standards are considered during the selection of groundwater remediation goals. Groundwater in Nassau County is classified as GA. There are no surface water bodies near or downgradient of Site 1.
Groundwater	New York State Public Water Supply Regulations	Drinking water quality standards for New York.	Potential site contamination impact on public water supply to be addressed by, or potentially caused by, environmental action.	10 NYCRR Part 5, Subpart 5-1; 5-1.52 Tables	Relevant and Appropriate	The aquifer, which is a drinking water source, is impacted by site contamination. New York State Department of Health (NYSDOH) MCLs were selected as Preliminary Remediation Goals (PRGs).
Soil	New York State Department of Environmental Conservation (NYSDEC) Soil Cleanup Objectives for Unrestricted Land Use	Provides a basis and procedure to determine soil cleanup levels.	Contaminated soils can be screened for potential risk.	10 NYCRR, Part 375, Subpart 375-6, Table 375-6.8(a)	Relevant and Appropriate	Soil cleanup standards for unrestricted use can be used as a screening for the unrestricted use scenario.
Soil	NYSDEC Soil Cleanup Objectives for Industrial Use, Commercial Use, and for the Protection of Groundwater	Provides a basis and procedure to determine soil cleanup levels to protect potential receptors in Industrial and Commercial Use scenarios, and provides guidelines to prevent migration of soil contamination to groundwater in a human health risk scenario.	Contaminated soils can be screened for the risk to future receptors.	10 NYCRR, Part 375, Subpart 375-6, Table 375-6.8(b)	Relevant and Appropriate	Soil cleanup standards impact selection of soil remediation goals.
Groundwater to Surface Water	NYSDEC Groundwater Quality Standards	Provides water quality standards for specific substances or chemical groups for applicable water classes.	Standards used to protect groundwater quality from taste-, color- and odor-producing, toxic and other deleterious substances.	Chapter X, Part 703, Subpart 703.5, Table 1: Water Quality Standards for Class GA Groundwater	Relevant and Appropriate	The aquifer is impacted by site contamination. The aquifer beneath Site 1 is a sole source aquifer, with public water supply wells downgradient of the site. NYSDEC groundwater quality standards are considered in the development of PRGs.
Air	NYSDOH Air Guideline Values	Provides indoor air and sub-slab vapor standards for tetrachloroethene and trichloroethene.	Standards used to protect residents from indoor air pollutants.	NYSDOH Soil Vapor Intrusion Guidance (2006), Table 3.1 Indoor Air, Table 3.3 Subslab Vapor (Matrix 1 and 2), and as modified by updates through August 2015	To Be Considered	Would be considered in vapor intrusion considerations if the soil vapor extraction containment (SVEC) system is no longer operational.
Air	NYSDEC DAR-1:Guidelines for the Control of Toxic Ambient Air Contaminants	Provides screening values for indoor air quality.	Values used to screen indoor air quality to identify potential concerns from vapor intrusion.	Department of Air Resources (DAR) - 1 and annual AGC/SGC Tables	To Be Considered	Would be considered in vapor intrusion considerations if the soil vapor extraction (SVE) containment system is no longer operational.

CFR - Code of Federal Regulations.
NPDWR - National Primary Drinking Water Regulations.
NYSDOH - New York State Department of Health.
NYSDEC - New York State Department of Environmental Conservation.
NYCRR - New York Codes, Rules, and Regulations.
DAR - Department of Air Resources.
MCLs - Maximum Contaminant Levels.
PRGs - Preliminary Remediation Goals.
SVEC - Soil Vapor Extraction Containment System.
AGC - Annual Guideline Concentrations.
SGC - Short-term Guideline Concentrations.
TSCA - Toxic Substances Control Act.
PCBs - Polychlorinated biphenyls.

TABLE 3-2
LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE NEW YORK

MEDIA	REQUIREMENT	DESCRIPTION	PREREQUISITE	CITATION	ARAR DETERMINATION	COMMENT
FEDERAL LOCATION SPECIFIC ARARs						
Groundwater	Safe Drinking Water Act (SDWA) Sole Source Aquifer	SDWA prevents federal funding from being committed to any project that may contaminate a "sole source aquifer," meaning any United States Environmental Protection Agency (USEPA)-designated aquifer that is the only principal drinking water supply for a given area which, if contaminated, would present a significant human health hazard.	Evaluate whether remedial activities would increase pre-existing contamination of sole source aquifers.	40 CFR 149.3	Applicable	The aquifer beneath Nassau County is a sole source aquifer (43 FR 26611). All active-technology alternatives that treat site soil and groundwater and do not have components that would further contaminate the sole source aquifer. Standards would be applicable for Alternative 5A, in which a solvent is injected into the subsurface.
NEW YORK STATE LOCATION SPECIFIC ARARs						
Groundwater	New York State Department of Environmental Conservation (NYSDEC) Water Classifications and Standards of Quality and Purity	Provides state classification system for groundwater.	Standards are used to protect the public health or welfare and enhance water quality.	6 NYCRR 701.15	Applicable	Groundwater in this area is classified as Class GA. 6 NYCRR 701.15, "The best usage of Class GA waters is as a source of potable water supply."

CFR - Code of Federal Regulations.
NYSDEC - New York State Department of Environmental Conservation.
NYCRR - New York Codes, Rules, and Regulations.
DOD - Department of Defense
DOE - Department of Energy
SDWA - Safe Drinking Water Act
FR - Federal Register

TABLE 3-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

MEDIA	REQUIREMENT	Description	PREREQUISITE	CITATION	ARAR DETERMINATION	COMMENT
FEDERAL ACTION-SPECIFIC ARARs						
Groundwater	Safe Drinking Water Act (SDWA) Underground Injection Control (UIC) Program	Regulations establish minimum requirements for UIC programs.	Actions are taken when contaminants that could be introduced by way of a UIC program could endanger drinking water sources.	40 CFR 144.81 and 0.82	Applicable	Applicable for alternatives that would involve either injection of solvent or stabilization material into the subsurface via Class V wells (Alternatives S4, S-5A, S-5B).
Fuel and Oil	Materials Management	When cumulative onsite bulk storage volume of fuel and/or oil is greater than 1,320 gallons, stored in containers greater than 55 gallons (e.g. drums or tanks), must be secondarily contained, inspected on a routine basis, have a Spill Prevention Control and Countermeasures (SPCC) plan prepared, and meet other SPCC criteria.	Fuels and oils stored on site in containers greater than 55 gallons when cumulative onsite bulk storage volume is greater than 1,320 gallons.	40 CFR 112.3 and -.6	Applicable	Applicable for Alternative S-5B which includes temporary onsite staging for solvent and waste solvent (VertecBio Gold #4). Any solvent would be stored in appropriate containers and controlled areas as appropriate.
Soil	Final Covers on Hazardous Waste Landfills and Surface Impoundments	Provides guildance on contruction practices for impermeable caps.	Design and Construction of an impermable cap at Site 1.	OSWER USEPA 530-SW-89-047	To Be Considered	Design of a cap for Site 1 residual contaminated soils will likely be based on design principles provided in the guidance. (Alternatives S-3, S-4, S-5A, S-5B)
STATE ACTION-SPECIFIC ARARs						
Fuel and Oil	Materials Management	State regulation of bulk oil storage tanks (greater than 1,100 gallons), including design requirements, reporting, and inspections. Program is administered by Nassau County.	Applies to new petroleum tank construction with more than 1,100 gallons of capacity.	6 NYCRR Parts 615.8 to 0.14	Applicable	Applicable for Alternative S-5B, which includes temporary onsite staging for waste oils and solvents such as VertecBio Gold #4. Any solvents would be stored in appropriate containers and controlled areas as appropriate.
Hazardous Waste	New York Identification and Listing of Hazardous Waste Regulations	Characterization, identification, and management of wastes.	Generation of hazardous wastes.	6 NYCRR 371.3, 371.4, 372.2, 373-1.1	Applicable	Applicable for action alternatives to characterize and manage waste materials (i.e. soils) and prior to offsite disposal (S-2 to S-7), (G-2, G-3A, G-3B), (SV-3).
Air	New York Air Pollution Regulations	Regulations for the control and prevention of air pollutants.	Generation of off-gas.	6 NYCRR Parts 212.1.5 and 2.3	Applicable	Alternatives with off-gas treatment (SV-3) may need to be screened against these standards for compliance purposes.
Soil	NYSDEC Erosion and Sediment Control	Provides guidance on managing storm water and potential runoff during construction activites to be compliant with the New York Pollution Discharge Elimination System.	Soil disturbances	New York Standards and Specifications for Erosion and Sediment Control, (August 2005)	To Be Considered	Provides guidance for control erosion of contaminated media to the recharge basins during construction.
Contaminated Site	NYSDEC Inactive Hazardous Waste Disposal Site Regulations	New York remediation program for sites listed on the New York State Registry or the National Priority List, or being addressed by US Department of Defense (DOD) or Department of Energy (DOE).	Navy Environmental Restoration site.	6 NYCRR 375 Parts 1.1 to 1.12	Applicable	NWIRP Bethpage is not on the National Priority List, but is listed as a Classification 2 in the NYSDEC Registry of Inactive Hazardous Waste Disposal Sites and is a DOD-owned site. Applicable to all the action alternatives.

CFR - Code of Federal Regulations.
NYSDEC - New York State Department of Environmental Conservation.
NYCRR - New York Codes, Rules, and Regulations.
MCL - Maximum Contaminant Level.
TSCA - Toxic Substances Control Act.
SPCC - Spill Preventation Control and Countermeasures.
UIC - Underground Injection Control.
OSWER - Office of Solid Waste and Emergency Response.

TABLE 3-4
PRELIMINARY REMEDIATION GOALS FOR SITE SOILS
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Chemical	C / N	Protection of Public Health Commercial Use (mg/kg) [1]	Protection of Public Health Industrial Use (mg/kg) [1]	Restricted Use for the Protection of Groundwater (mg/kg) [1]	Unrestricted Use Soil Cleanup Objectives (mg/kg) [2]	EPA Regional Screening Levels Residential Soil / Industrial Soil (mg/kg) [3]		1995 Record of Decision (ROD) Preliminary Remediation Goals (PRGs)	PRG for Depth Interval 0 to 2 Feet [4]	PRG for Depth Interval 2 to 10 Feet [4]	PRG for Depth Interval 10 to 50 Feet [4]	PRG for Depth Interval 50 to 70 Feet [5]
METALS												
Arsenic	C	16 [6]	16 [6]	16 [6]	13 [6]	0.67	3.0	5.4	16	16	16	16
Cadmium	N	9.3	60	7.5	2.5	70	980	--	9.3	9.3	9.3	7.5
Chromium, hexavalent	C	400	800 [8]	19	1.0 [10]	0.3	6.3	--	400	400	400	19
PESTICIDES												
Chlordane	C	24	47	2.9	0.094	1.8	8.0	0.206	24	24	24	2.9
SVOCs												
Benzo(a)anthracene	C	5.6	11	1.0 [6]	1.0 [6]	0.15	2.9	0.330	5.6	5.6	5.6	1.0 [6]
Benzo(a)pyrene	C	1.0 [6]	1.1	22	1.0 [6]	0.015	0.29	0.330	1.0 [6]	1.0 [6]	1.0 [6]	22
Benzo(b)fluoranthene	C	5.6	11	1.7	1.0 [6]	0.15	2.9	0.330	5.6	5.6	5.6	1.7
Benzo(k)fluoranthene	C	56	110	1.7	0.8 [6]	1.5	29	0.330	56	56	56	1.7
Chrysene	C	56	110	1.0 [6]	1.0 [6]	15	290	0.330	56	56	56	1.0 [6]
Dibenz(a,h)anthracene	C	0.56	1.1	1,000 [9]	0.33 [10]	0.015	0.29	0.330	0.56	0.56	0.56	1,000 [9]
Indeno(1,2,3-cd)pyrene	C	5.6	11	8.2	0.5 [6]	0.15	2.9	0.330	5.6	5.6	5.6	8.2
VOCs												
1,1,1-Trichloroethane	N	500 [7]	1,000 [9]	0.68	0.68	8,100	36,000	0.01	500 [7]	500 [7]	500 [7]	0.68
Trichloroethene	C	200	400	0.47	0.47	0.94	6.0	0.01	200	200	200	0.47
Tetrachloroethene	C	150	300	1.3	1.3	24	100	0.027	150	150	150	1.3
PCBs	C	1.0	25	3.2	0.1	--	--	1 to 10	1.0	1.0	1.0	3.2

Values are in parts per million (ppm) or milligrams per kilogram (mg/kg). VOC = volatile organic compound DAF = dilution attenuation factor

SVOC = semi-volatile organic compound PCB = polychlorinated biphenyl Carcinogenic = C / Non-carcinogenic = N

1 - Soil Screening Objective: New York State Department of Environmental Conservation (NYSDEC) Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for Commercial, Industrial, and for the Protection of Groundwater. DAF = 100 based on a total organic carbon (TOC) content of 1%. Non-cancer values (non-carcinogenic) are developed from USEPA and ATSDR reference doses. Cancer values (carcinogenic) are based on a risk value of 1 X 10^{-6}.

2 - Soil Screening Objective: NYSDEC Part 375 - 6.8(a), Unrestricted Use Soil Cleanup Objectives. DAF = 100 based on a total organic carbon (TOC) content of 1%. Non-cancer values (non-carcinogenic) are developed from USEPA and ATSDR reference doses. Cancer values (carcinogenic) are based on a risk value of 1 X 10^{-6}.

3 - Environmental Protection Agency (EPA) Regional Screening Levels - Residential / Industrial. Carcinogenic risks are for a risk value of 1 X 10^{-6}. Non-carcinogenic risks are calculated for a Hazard Index equal to 1. November 2014 values.

4 = NYSDEC Part 375-6.8 (b), Restricted Use for the Protection of Public Health Commercial Use values were used for surface soils because of future site use.

5 = NYSDEC Part 375-6.8(b), Restricted Use for the Protection of Groundwater Soil Screening Objectives were used as PRGs for saturated site soils. Based on New York State Department of Health (NYSDOH) Maximum Coontaminant Limits (MCLs) for GA groundwater standards, with a DAF = 1 and a TOC = 1%.

6 - If value is less than the rural soil background concentration as determined by the Department of Health rural soil survey, the rural soil background concentration will be used as the soil screening objective value.

7 - This value is capped at a maximum of 500 ppm or 500 mg/kg.

8 - The soil screening objective for this compound (or family of compounds) is considered to be met if the analysis for the total species of this contaminant is below the specific soil screening objective.

9 - This value is capped at a maximum of 1,000 ppm or 1,000 mg/kg.

10 - If this value is lower than the Contract Required Quantitation Limit (CRQL), then the CRQL is used.

TABLE 3-5
PRELIMINARY REMEDIATION GOALS FOR SITE GROUNDWATER
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Chemical	Carcinogenic (C)/Non-carcinogenic (N)	USEPA Regional Screening Level [(1)] (μg/L)	USEPA Maximum Contaminant Levels (MCLs) (μg/L) [(2)]	NYSDOH MCLs (μg/L) [(3)]	NYSDEC Groundwater Quality Standards [(4)]	Preliminary Remediation Goal (μg/L)
METALS						
Arsenic	C	0.045	10	10	25	10
Chromium, total	N	22,000	100 [(5)]	100 [(5)]	50	100
Chromium, hexavalent	C	0.035	100 [(5)]	100 [(5)]	50	100
POLYCHLORINATED BIPHENYLS (PCBs)	C	0.17	0.5	0.5	0.09	0.5

μg/L = micrograms per liter

1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels. Values are based on a target carinogenic risk of 1 X 10^{-6} (HI = 1).

2 - USEPA Maximum Contaminant Levels (MCLs).

3 - New York State Department of Health (NYSDOH) Maximum Contaminant Limits (MCLs).

4 - New York State Department of Environmental Conservation (NYSDEC) Part 703.5 Table 1 Water Quality Standards Class GA groundwater.

5 - Value is for total chromium.

TABLE 3-6
PRELIMINARY REMEDIATION GOALS FOR INDOOR AIR
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Chemical	Carcinogenic (C)/Non-carcinogenic (N)	Indoor Air - USEPA Regional Screening Level [(1)] ($\mu g/m^3$)	NYSDOH Indoor Air ($\mu g/m^3$) [(2)]	NYSDOH Indoor Air Guidance ($\mu g/m^3$) [(3)]	Preliminary Indoor Air Remediation Goal ($\mu g/m^3$)	Preliminary Fence Line Soil Gas Remediation Goal ($\mu g/m^3$)[4]
Volatile Organics						
Tetrachloroethene	C	11 (42)	4	100	42	1,400
Trichloroethene	C	0.48 (2.1)	0.2	5	2.1	69

$\mu g/m^3$ = micrograms per cubic meter.
1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels. Values are based on a target carinogenic risk of 10^{-6} (HI = 1).
2 - New York State Department of Health, 6 NYCRR Part 212 DAR-1 AGC/SGC Tables.
3 - NYSDOH Soil Vapor Intrusion Guidance (2006), Table 3.1 Indoor Air, Table 3.1 Indoor Air, Table 3.3 Subslab Vapor (Matrix 1 and 2).
4 - Based on USEPA Vapor Intrusion Guidance, a soil gas to indoor air value of 33 to 1 is used.

TABLE 4-1
GENERAL RESPONSE ACTIONS (GRAs)
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action (GRA)	Effect Associated with Remedial Action Objectives (RAOs)
No Action	None. Serves as a baseline to compare other response actions as a requirement under CERCLA.
Institutional Controls	Reduces human exposure to contaminated soils, soil vapor, or groundwater by restricting activites or aquifer use that may result in exposure. Monitoring may be performed in conjunction with other alternatives to determine if RAOs are being met or if/when cleanup goals are met.
Containment	Minimizes or prevents the migration of contaminants in the soils to surrounding groundwater and receptors. Also could minimize or eliminate migration of contaminated soil vapor and groundwater.
Removal	Removes contaminants by physical extraction of either impacted soil, soil vapor, or groundwater.
Disposal/Reuse/ Discharge	Long-term containment of contaminated material or repurposing of clean material.
Ex-Situ Treatment	Treatment of contaminated media in an above ground system, using chemical, physical, and/or biological processes.
In-Situ Treatment	Treats contaminants in place via chemical, biological, and/or physical processes.

TABLE 4-2
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS AND GROUNDWATER
SITE 1 FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action	Remedial Technology	Process Options	Medium			Description	Chemical Class				Screening			
			Soil	Soil Vapor	Groundwater		PCBs	SVOCs	Chlorinated VOCs	Metals	Effectiveness	Implementability	Relative Cost	Screening comments
No Action	No Action	Not Applicable	√	√	√	No activities conducted at site to address contamination.	√	√	√	√	Not effective, does not achieve preliminary remediation goals (PRGs) and there is no evaluation of potential impacts to human health and the environment.	Readily implementable, no actions required.	Low.	**Retained.** Provides basis of comparison to other technologies.
Institutional Controls	Administrative restrictions	Land-Use Controls (LUCs) / Deed Restrictions and Notices	√	√	√	Administrative action is used to restrict groundwater use and future site activities. Deed restrictions could consist of land use and groundwater use restrictions and the need to address vapor intrusion in on-property structures.	√	√	√	√	Deed restrictions are moderately effective as stand alone actions as wells as to enhance the effectiveness of other technologies. Soils were compared to New York State Department of Environmental Conservation (NYSDEC) Soil Cleanup Objectives and New York State Department of Health (NYSDOH) maximum contaminant limits for groundwater to note which media would need environmental restrictions.	Easy to implement on site. Would be more difficult to extend off-site. Normally combined with other technologies to enhance performance. Can be used for short-term or long-term remedies. Can be removed. Once environmental investigations are finished on property, the site will be transferred for future industrial use.	Low.	**Retained.** Deed restrictions will be in place while contamination remains in place in soil, groundwater, and soil vapor.
	Access Restrictions	Fences	√			Security fences installed around potentially contaminated areas to limit access. A Navy property line (fence line) is already in place, and borders the site along the north, east and south.	√	√	√	√	Can be used to effectively prevents the public from entering site, and provides site security.	Site contamination is located within existing facility boundaries.	Low.	**Retained.** Existing fencing will be maintained to restrict access to the site soil.
	Monitoring/ Sampling	Performance and Compliance Monitoring		√	√	Sampling and analysis to evaluate the migration of contaminants within or the potential leaching of contamination from soils to groundwater.	√	√	√	√	Enhances the effectiveness of other technologies to ensure protectiveness of remedies.	Easily implemented. Generate monitoring plan and sample on established schedule. Minimal infrastructure and O&M required.	Low annual costs, but long-term costs can be moderate because of extended period of operation.	**Retained.** Retained for soil vapor and groundwater.
	Monitoring of Natural Attenuation (MNA)	Process and Performance Monitoring		√	√	Natural attenuation (all mechanisms including biodegradation, dilution, etc.) coupled with regular monitoring to identify indicators of biodegradation.	√	√	√	√	Effective for sites where there are no unacceptable current risks (no exposure) and future risks are minimal. Current site contamination shows PCBs and metals in both soils and groundwater, in addition to chlorinated VOCs and SVOCs in soil. PCB and metal contamination in soil may be contributing to groundwater contamination.	Easily implemented; sampling would be required to monitor progress of attenuation. Minimal infrastructure and O&M required.	Low annual costs, but long-term costs can be moderate because of an extended period of operation.	**Retained.** Retained for soil vapor and groundwater.
Containment	Cover	Soil/Gravel Cover	√			Use of permeable material (e.g., soil) to prevent exposure to contamination. Specified in the existing Operable Unit No. 1 Record of Decision (ROD) to allow VOCs to flush to groundwater.	√	√	√	√	Would prevent potential receptors from direct contact with contaminated soil. Surface soils at this site are contaminated with PCBs and metals. Soil cover would not be effective in preventing the migration of PCBs and metals in site soil to groundwater.	Easily implemented, and materials and services required to implement this technology are readily available. A permeable cover would allow infiltration of precipitation that would promote attenuation of VOCs. The site is relatively flat except for a 4 foot vegetated windrow on the eastern end, and a mounded area that partially buries the existing sanitary settling tank.	Low.	**Retained.** Specified in the current Record of Decision.

TABLE 4-2
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS AND GROUNDWATER
SITE 1 FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action	Remedial Technology	Process Options	Medium			Description	Chemical Class				Screening			
			Soil	Soil Vapor	Groundwater		PCBs	SVOCs	Chlorinated VOCs	Metals	Effectiveness	Implementability	Relative Cost	Screening comments
Containment (cont.)	Capping	Capping	√			Use of impermeable or semi-permeable materials (e.g., soil, clay, synthetic membrane) to prevent exposure to contamination and/or reduce the vertical migration of contaminants to groundwater. A RCRA landfill cap would consist of multiple layers consisting of a soil layer, drainage layer, synthetic liner, and clay layer.	√	√	√	√	Cover would prevent potential receptors from direct contact with contaminated soil and prevent infilration that results in PCB and metal migration to groundwater.	Installation would be easy, and materials and services required to implement this technology are readily available. The site is relatively flat except for a 4 foot vegetated windrow on the eastern end, and a mounded area that partially buries the existing sanitary settling tank.	Moderate.	**Retained.** A cap would manage direct contact and infiltration of precipitation and continued potential for soil contamination to leach to groundwater.
	Barriers	Vertical Barriers		√	√	Vertical barriers are made of impermeable or semi-permeable materials to prevent or minimize passage of contaminants through barrier walls. Walls can be made of a slurry mixture (i.e. bentonite and water) or sheet piling. Walls extend to a low-permeability layer (i.e. clay) to prevent seepage of contaminants beneath the walls.	√	√	√	√	Barriers are effective at keeping contaminated groundwater from flowing to clean areas. Walls are protective if inspected and properly maintained. Monitoring can be used to determine whether contaminant migration is occurring.	Would be implementable. Walls would need to extend beyond the depth of contamination (beyond 65 feet) and extend to a low-permeability layer (i.e clay) to provide effective containment. Laterally thin clay lenses are present throughout the site, but are discontinuous.	Costs associated with this technology are moderate due to the depth of contamination.	**Retained.**
Removal	Extraction Wells with Pump/ Blowers	Groundwater/ Soil Vapor Extraction System		√	√	Wells are installed to strategically access soil vapor or groundwater. Pumps or blowers are used to extract the contaminated fluid and transport them to the surface for treatment. Based on placement, extraction systems can be used to contain fluids or to accelerate contaminant removal. The existing ONCT and SVE Containment System extraction systems would be used.	√	√	√	√	The use of extraction wells has been demonstrated to be very effective at capturing contaminated groundwater and soil vapor.	Extraction systems are currently in place for both soil vapor and groundwater.	Moderate.	**Retained.** Extraction systems will be retained for soil vapor and groundwater.
	Bulk Excavation	Bulk Excavation	√			Mechanical removal of solid materials using construction equipment.	√	√	√	√	Excavation is a well-proven and effective method. Excavation would remove remaining contaminated soils. Confirmation sampling would verify the effectiveness of the removal action.	Would be difficult to implement due to the depth of contamination (detections greater than 1 mg/kg up to 65 feet), and presence of contaminated saturated and unsaturated soils.	High.	**Retained.** Bulk excavation will be retained for soil.
Disposal / Reuse/ Discharge	Landfill	Landfill	√			Disposal of excavated material in an off-site landfill. Based on waste characterization, landfill would be hazardous or nonhazardous.	√	√	√	√	Contaminated material is disposed at a permitted landfill. Off-site treatment may be required prior to disposal.	Excavation would be more difficult due to the depth of contaminated soils.	Cost is moderate (non-hazardous) to high (hazardous).	**Retained.** Disposal options will be retained.
	Recycling and Salvage	Recycling and Salvage	√			Recycling of fill materials components instead of disposal.				√	Involves re-use of site components.	Can be considered as a secondary technology.	Low.	**Retained.** Recycling of concrete and metal may be considered.
	Consolidation	Consolidation	√			Relocation of untreated soil on site.	√	√	√	√	Effective if uncontaminated soils can be used as backfill, and other soils could be segregated onsite.	Implementable as combined with excavation and other technologies if waste soils are present. The site is located in an industrial area and limited space is available.	Low.	**Retained.** Consolidation options will be considered based remedy optimization.

TABLE 4-2
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS AND GROUNDWATER
SITE 1 FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action	Remedial Technology	Process Options	Medium			Description	Chemical Class				Screening			
			Soil	Soil Vapor	Groundwater		PCBs	SVOCs	Chlorinated VOCs	Metals	Effectiveness	Implementability	Relative Cost	Screening comments
Disposal / Reuse/ Discharge	Discharge	Discharge		√	√	The discharge of water or vapors to the environment, in accordance with certain limits, often after treatment.	√	√	√	√	Effective at recyling media back into the environment. Treatment of the fluids is often required.	Discharge is readily implementable, with well established programs in place.	Low	**Retained.**
	Beneficial Reuse	Beneficial Reuse as Fill Material	√			On-site reuse of uncontaminated or treated soil.	√	√	√	√	Would be effective as uncontaminated soils can be used as backfill.	Implementable as combined with excavation and other technologies if waste soils are present.	Low.	**Retained.**
Ex-Situ Treatment	Thermal	Incineration	√			Volatilization and oxidation of organic compounds via conveyance through high temperature.	√	√	√		Effective technology used to volatilize and destroy organic wastes including chlorinated hydrocarbons.	Would be implemented on waste soils if treatment is required prior to off site disposal at a hazardous waste landfill.	High.	**Not selected.** Not selected due to high cost.
		High-Temperature Thermal Desorption	√			Wastes are heated to 600 to 1,000 degrees Fahrenheit to volatilize organics. Often used in combination with incineration.	√	√	√		Proven effective at reducing concentrations of petroleum products and related chemicals.	Off-gas requires treatment to capture contaminants.	High.	**Not selected.** Not selected due to high cost.
	Biological	Landfarming	√			Contaminated soil, sediment, or sludge is excavated, applied into lined beds and periodically turned over to aerate waste.	√	√	√		Contaminants serve as the carbon and energy source to promote oxygen transfer using typical agricultural equipment. Effective for fuels and more volatile hydrocarbons, but may have limited effectiveness on difficult to degrade PCBs and SVOCs.	Significant space is required. Site 1 is located in an industrial area without adequate space.	High	**Not selected.** May have limited effectiveness for target contaminant group.
	Biological	Slurry Phase Treatment	√			Treatment of contaminated material in a slurry reactor under controlled conditions using natural or cultured microorganisms to biodegrade organics.		√	√		Uses innovative technologies to treat biodegradable organics.	Long residence times may be required for treatment. Treatability studies would need to be performed to determine design parameters like degradation rates and nutrient requirements.	High	**Not selected.** May have limited effectiveness for target contaminant group.
	Chemical	Oxidation	√		√	Use of strong oxidizers such as ozone, peroxide, chlorine, or permanganate to chemically oxidize materials. Treated soil or groundwater may be returned to the site.	√	√	√	√	Chemical oxidation is proven effective in treating VOCs in groundwater; however its use in treating soils with PCB contamination is limited and still experimental.	Good control of dosing and treatment efficacy. Destroys or alters organic contaminants to less toxic or non-toxic forms.	High.	**Not selected.** May have limited effectiveness for target contaminant group.
		Dehalogenation	√			Contaminated soil is screened and mixed with reagents. The mixture may then be heated.	√	√	√		Process is either achieved by the replacement of halogen molecules or partial volatilization. Technology may have limited effectiveness on PCBs.	Reagent requirements increase based on the type of soil matrix.	High.	**Not selected.** May have limited effectiveness for target contaminant group.
		Lime Addition	√			Lime is mixed with soil to destroy PCBs. Treated soil is returned to the site.	√				This technology is experimental for PCBs. The primary loss mechanism is volatilization; PCB decomposition products are not seen at high levels after treatment.	Would be difficult because treatment with lime occurs after soil is excavated.	High.	**Not selected.** High cost of treatment may not provide benefits over traditional disposal.
		Base-catalyzed decomposition (BCD)	√			Soil is excavated and mixed with sodium bicarbonate, heated in a reactor, and volatilized contaminants are captured and treated separately.	√	√	√		The use of sodium bicarbonate allows for lower temprature desorption and partial destruction of organics. This technology is applicable to PCBs, but is experimental.	Would be difficult because excavation is required prior to additional treatment.	Costs are high due to the cost of additional treatment with excavation.	**Not selected.** High cost of treatment may not provide benefits over traditional disposal.

TABLE 4-2
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOILS AND GROUNDWATER
SITE 1 FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action	Remedial Technology	Process Options	Medium			Description	Chemical Class				Screening			
			Soil	Soil Vapor	Groundwater		PCBs	SVOCs	Chlorinated VOCs	Metals	Effectiveness	Implementability	Relative Cost	Screening comments
Ex-Situ Treatment (cont.)	Physical	Granular Activated Carbon		√	√	Extracted soil vapor or groundwater is pumped from the subsurface and treated with granular activated carbon as needed to comply with regulatory requirements and risks to human health. The existing ONCT and SVE Containment System would be used.	√		√		GAC is effective for removing PCBs and chlorinated VOCs from extracted soil vapor and groundwater.	Vendors are readily available and this technology is commonly used in this application.	Moderate.	**Retained.** Modifications to the existing ONCT system can be used to address PCBs in groundwater. The existing SVE Containment system uses GAC.
	Physical (cont.)	Ion Exchange			√	Extracted groundwater is pumped from the subsurface and treated with ion exhange to remove hexavalent chromium. Selective anionic resins would be considered.				√	Ion exchange is effective in removing hexavalent chomium from extracted groundwater.	Vendors are readily available. There are only limited applications using ion exchange for removal of low concentrations of hexavalent chromium.	High.	**Retained.** Modifications to the existing ONCT system can be used to address hexavalent chromium.
		Solidification / Stabilization	√			Excavated soil is mixed with Portland cement and bentonite. Treated soil is returned to the site.	√	√	√	√	Process would require excavation of contaminated soils prior to treatment. Would be used to stabilize PCB contaminants within soil to prevent continued leaching to groundwater.	Would be difficult to implement due to the requirement of excavation, and the depth of contamination.	Costs are high due to the cost of additional treatment with excavation.	**Not selected.** High cost of treatment may not provide benefits over traditional disposal.
	Physical	Soil Flushing / Surfactant Solvent washing and recovery	√			Soil is mixed with solvent to remove contaminants from soil. Solvent carrying contaminants may need treatment and/or disposal. Treated soil may be returned to the excavation.	√	√	√	√	Process would require excavation of contaminated soils prior to treatment. In-situ soil washing with solvent would be implementable and would not require treatment prior to excavation.	Would be difficult to implement due to the requirement of excavation, and the depth of contamination.	Costs are high due to the cost of additional treatment with excavation.	**Not selected.** High cost of treatment may not provide benefits over traditional disposal.
In-Situ Treatment	Thermal	Hot Air Injection (Thermally Enhanced Soil Vapor Extraction)	√		√	Use of hot air to heat and volatilize contaminants.	√	√	√		This technology is designed to treat SVOCs but will also treat VOCs. May be less applicable to treat PCBs. A soil vapor extraction containment system already exists on site to prevent migration of VOC vapors.	Off-gas may require additional treatment.	Moderate.	**Not selected.** More expensive than traditional soil vapor extraction.
	Biological	Biosparging	√			Contaminant-free air is injected into the subsurface to provide oxygen to promote aerobic degradation.	√	√			Biosparging has been proven effective in treating soils contaminated by petroleum residuals and other organic chemicals. May have limited effectiveness on target contaminant groups.	Biosparging is becoming more common, and hardware required for remediation is readily available.	Costs associated with this technology are moderate, and are dependent upon surface area of contamination and soil type.	**Not Selected.** May have limited effectiveness for target contaminant group (PCBs).
		Nutrient Enhanced Biosparging	√			Air and nutrients (nitrogen and phosphorus) are injected into the subsurface to provide oxygen to promote aerobic degradation.	√	√			Remediation is dependent upon a number of factors including ground temperature, soil content and soil moisture. Fungal and bacterial treatments of saturated soils can be used to degrade PCBs. Bacterial degradation of PCBs is still experimental, and may require additional pilot studies to determine effectiveness. Would be more effective for SVOCs.	Would be implementable. When conducted in-situ, it does not require initial excavation of site contaminants.	Costs associated with this technology are moderate depending upon the time to clean-up and the presence of indigenous microorganisms.	**Not Selected.** May have limited effectiveness for target contaminant group (PCBs).

General Response Action	Remedial Technology	Process Options	Medium			Description	Chemical Class				Screening			
			Soil	Soil Vapor	Groundwater		PCBs	SVOCs	Chlorinated VOCs	Metals	Effectiveness	Implementability	Relative Cost	Screening comments
In-Situ Treatment (cont.)	Physical	Solidification / Stabilization (Soil Mixing)	√			Soil is mixed with a slurry (e.g. bentonite, and/or other materials) in a defined volume to contain contaminants within a hardened underground form. Combined with monitoring to determine long-term effectiveness and permanence (integrity) of solidified materials.	√	√	√	√	This technology is well demonstrated. Soil mixture is a well-defined volume, and the cured mixture can be readily tested to verify integrity. There are limited applications for soil mixing beyond 50 feet (contamination at this site extends to 65 feet.) Treats the soil in columns, and limited auger diameters exist for deep borings.	Vendors are available, however, applications may be limited at depths beyond 50 feet. Utilities may require relocation prior to in-situ mixing. If utilities remain, there is a limited distance the auger can approach surrounding utilities, limiting angling of mixing. May increase subsurface soil volume. Would affect future site use.	Costs associated with this technology are high considering the depth of contamination and potential relocation of utilities.	**Not Selected.** Soil contamination at this site requires treatment at depths beyond 50 feet below ground surface.
	Physical (cont.)	Solidification / Stabilization (Jet Mixing)	√			Slurry mixture is dispersed through an open borehole to contain contaminants in an underground form. Combined with monitoring to determine long-term effectiveness and permanence.	√	√	√	√	This technology is well demonstrated. Soil mixture is a well-defined volume, and the cured mixture can be readily tested to verify integrity. Would be effective at depths up to and exceeding 100 feet bgs.	Vendors are available. Utilities may require relocation prior to in-situ mixing. The radius of influence of jet mixing is often larger than soil mixing, and more accurate angling beneath the ground surface (in proximity of utilities) may be permitted. Some holes may need to be pre-drilled so auger rods may be advanced to the depths required. The auger borehole must remain open during jet mixing. May increase subsurface soil volume. Would affect future site use.	Costs associated with this technology are high considering the depth of contamination and potential relocation of utilities.	**Retained.**
		Soil Flushing / Solvent Extraction	√			Extraction of contaminants with suitable aqueous solutions.	√	√	√	√	Bench scale tests were completed using an organic solvent (VertecBio Gold #4) to remove PCBs from soil. PCB concentrations were reduced from 270 mg/kg to an average concentration of approximately 6.4 mg/kg. Concentrations at Site 1 range from less than 1 mg/kg to 3,800 mg/kg, and up to 45,000 mg/kg at the dry wells.	Solvent extraction would be implementable; however, a large amount of solvent would be required for mutiple extractions. During bench scale tests, clean solvent was used during each extraction. Recycling solvent would reduce solvent volumes required.	Costs associated with this technology are moderate to high.	**Retained.**
		Passive / Reactive Treatment Walls		√	√	Permeable reactive barriers treat fluids as they flow through barriers due to natural gradients in the subsurface. As contaminants pass through the barriers, they are converted to non-toxic or immobile species. Reactive materials vary with the contaminants present.			√	√	Reactive materials such as iron metal or organics can be used to reductively dechlorinate hydrocarbons or precipitate anions. May be less effective for the target contaminant group (PCBs).	Would be implementable but may require some degree of excavation and/or sheet piling to direct flow. Would be more difficult to implement due to the depth of contamination.	Costs are moderate due to the depth of contamination (up to 65 feet).	**Not Selected.** May have limited effectiveness for target contaminant group (PCBs).

PCB - polychlorinated biphenyl
SVOC- semi-volatile organic compound
VOC - volatile organic compound
√ - Applicable to medium or chemical class
mg/kg - milligram per kilogram.
ONCT - Onsite Containment System
SVE - Soil Vapor Extraction
O&M - Operation and Maintenance
GAC - Granular activated carbon
RCRA - Resource Conservation and Recovery Act

PRG - Preliminary Remediation Goal
LUCs - Land Use Controls
NYSDEC - New York State Department of Environmental Conservation
NYSDOH - New York State Department of Health
ROD - Record of Decision

TABLE 4-3
SUMMARY OF TECHNOLOGIES AND PROCESS OPTIONS RETAINED FOR DEVELOPMENT AND EVALUATION
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action	Remedial Technology	Process Options	Description	Area of Consideration
No Action	No Action	No Action	No activities conducted at the site to address contamination.	Provides a basis of comparison to other process options.
Institutional Controls	Administrative Restrictions	Land-Use Controls / Deed Restrictions	Administrative action is used to restrict groundwater use and future site activities involving contaminated soil, soil vapor, and groundwater.	Deed notifications will remain in place while soil, soil vapor, and groundwater contamination remains. May be combined with other remedial technologies.
	Access Restrictions	Fences	Security fences installed around contaminated areas to limit access.	A fence will be maintained around Site 1 while contaminated surface soil remains. May be combined with other remedial technologies.
	Monitoring / Sampling / Natural Attenuation	Performance and Compliance Monitoring	Sampling and analysis to evaluate the migration of contaminants within or the potential leaching of contamination from soils to groundwater and natural degradation over time.	Monitoring and sampling will be considered for evaluating the extent of impacted soil, soil vapor, and groundwater, and compliance monitoring for discharge of fluids to the environment.
Containment	Cover	Soil/Gravel Cover	Use of permeable material (e.g. soil) to prevent exposure to contamination.	Will be implemented in areas of residual soil contamination that do not require a reduction in infiltration.
	Capping	Capping	Use of impermeable or semi-permeable materials (e.g., soil, clay, synthetic membrane, asphalt) to prevent exposure to contamination and/or reduce the vertical migration of contaminants in groundwater.	Will be implemented in areas of residual soil contamination that require a reduction in infiltration.
	Vertical Barriers	Vertical Barriers	Vertical barriers are made of impermeable or semi-permeable materials to prevent or minimize passage of contaminants through barrier walls. Walls can be made of a slurry mixture (i.e. bentonite and water) or sheet piling. Walls typically extend to a low-permeability layer (i.e. clay) to prevent seepage of contaminants beneath the walls.	Will be implemented in areas surrounding soil contamination.
Removal	Extraction Wells with Pump/Blower	Groundwater/Soil Vapor Extraction System	Wells are installed to strategically access soil vapor or groundwater. Pumps or blowers are used to extract the contaminated fluid and transport them to the surface for treatment.	The existing SVE Containment System operating at the eastern edge of Site 1 and the the Onsite Containment System operating south of the NWIRP will continue to operate. Additional soil vapor extraction wells in the middle of Site 1 will be considered.
	Bulk Excavation	Bulk Excavation	Mechanical removal of solid materials using construction equipment.	Will be implemented in areas of soil contamination.

TABLE 4-3
SUMMARY OF TECHNOLOGIES AND PROCESS OPTIONS RETAINED FOR DEVELOPMENT AND EVALUATION
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

General Response Action	Remedial Technology	Process Options	Description	Area of Consideration
Disposal / Reuse / Discharge	Landfill	Landfill	Disposal of excavated material in an off-site landfill.	Contaminated soil from excavation activities will be disposed of in an off-site landfill. Some PCB- and metal-contaminated soil would require disposal under hazardous waste regulations.
	Discharge	Discharge	The discharge of water or vapors to the environment, in accordance with certain limits, often after treatment.	Groundwater and soil vapor will be discharged to the environment in accordance with regulatory and health requirements.
	Beneficial Reuse	Beneficial Reuse (as fill material)	On-site reuse of uncontaminated or treated soils.	Clean and/or treated soils from excavation activities can be reused on-site or in the excavation as fill material.
Ex-Situ Treatment	Physical	Granular Activated Carbon	Extracted soil vapor or groundwater is pumped from the subsurface and treated with granular activated carbon as needed to comply with regulatory requirements and risks to human health.	Modifications to the existing ONCT system can be used to address PCBs in groundwater. The existing SVE Containment system uses GAC.
		Ion Exchange	Extracted groundwater is pumped from the subsurface and treated with ion exhange to remove hexavalent chromium. Selective anionic resins would be considered.	Modifications to the existing ONCT system can be used to address hexavalent chromium.
In-Situ Treatment	Physical	Solvent Extraction	Extraction of contaminants with suitable aqueous solutions.	Will be implemented in areas of soil contamination.
		Solidification / Stabilization (jet mixing)	Soil is mixed with a slurry (e.g. bentonite, and/or other materials) in a defined volume to contain contaminants within a hardened underground form. Combined with monitoring to determine long-term effectiveness and permanence (integrity) of solidified materials.	Will be implemented in areas of soil contamination.

RCRA - Resource, Conservation, and Recovery Act
PCB - polychlorinated biphenyl
VOC - volatile organic compound
SVOC - semi-volatile organic compound
GAC - Granular Activated Carbon
ONCT - on site containment system
SVE - Soil Vapor Extraction

TABLE 5-1
FEASIBILITY STUDY CRITERIA
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Feasibility Study (FS) 9 National Oil and Hazardous Substances Pollution Contingency Plan (NCP) Criteria	
Analysis Factor	Description
Threshold Criteria	
Overall Protection of Human Health and the Environment	Describes how the alternative reduces risk to human health through contaminant exposure, reduces the threat to previously unaffected environmental media, and reduces the risk to ecological receptors.
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	Verifies that the alternative meets chemical, action, and location-specific ARARs (as described in Section 3).
Primary Balancing Criteria	
Long-term Effectiveness and Permanence	Discusses how the alternative manages future site risks during the period after the remedial action is complete.
Reductions of Toxicity, Mobility, and Volume Through Treatment	Discusses the treatment process involved with the alternative. Quantifies the amount of hazardous material treated, the scope of action taken to mitigate original risks, risks associated with treatment, and remaining residuals.
Short-term Effectiveness	Discusses how the alternative manages site risks during construction and implementation of the alternative.
Implementability	Discusses the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative.
Cost	Evaluates both capital and operation and maintenance costs.
Modifying Criteria [(1)]	
State Acceptance	Regulatory acceptance of the alternative.
Community Acceptance	Public acceptance of the alternative.

Notes:

1 = Public and regulatory acceptance of the alternative is evaluated in detail after the public comment period on the FS.

TABLE 5-2
COMPARATIVE ANALYSIS OF SOIL ALTERNATIVES
SITE 1 - FORMER DRUM MARSHALLING AREA
BETHPAGE, NEW YORK

Criteria	Alternative S-1: No Action	Alternative S-2: Permeable Cover, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), and LUCs	Alternative S-3: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), and LUCs	Alternative S-4: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barriers, and LUCs	Alternative S-5A: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solidifcation of PCB-Contaminated Soil (Greater than 50 mg/kg), and LUCs	Alternative S-5B: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solvent Extraction of PCB-Contaminated Soil (Greater than 50 mg/kg), and LUCs	Alternative S-6: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), Soil Cover, and LUCs	Alternative S-7: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 1 mg/kg)
Overall Protection of Human Health and the Environment	Alternative S-1 is not protective of human health and the environment. Workers and potential future residents could be exposed to contaminated soil through direct contact, ingestion, and inhalation. Contaminated soil could also erode and migrate into the nearby recharge basins. COCs in soil would continue to leach and impact groundwater for an extended period of time.	Alternative S-2 would be protective by providing a barrier between contaminated soil and potential receptors and erosion to the recharge basins. Leaching of PCBs and other COCs to groundwater would be reduced by excavation and offsite disposal of a portion of the contaminated soil. LUCs would be used to limit exposure and reuse of contaminated soil and to maintain the cover.	Alternative S-3 provides similar direct exposure and erosion protection as Alternative S-2, but would further reduce leaching of PCBs and other COCs to groundwater by effectively eliminating vertical migration of precipitation. LUCs would be the same as Alternative S-2.	Alternative S-4 is similar to Alternative S-3, except that a vertical barrier would also be used to control migration of PCBs and other COCs from saturated soil to groundwater.	Alternative S-5A is similar to Alternative S-3, except that contaminated soil would be treated to encapsulate contaminants and thereby limit the migration of PCBs and other COCs from soil to groundwater.	Alternative S-5B is similar to Alternative S-5A, except that contaminated soil would be treated to extract PCBs and other COCs from soil and thereby limit the migration of PCBs and other COCs from soil to groundwater.	Alternative S-6 is similar to Alternative S-2, except that excavation and off site disposal of contaminated soil would extend to approximately 65 feet below ground surface. The supplemental removal would remove PCBs and other COCs that could leach to groundwater.	Alternative S-7 would be protective by removing all the contaminated soil. The need for LUCs or potential for groundwater contamination would be eliminated.
Compliance with ARARs	Alternative S-1 would not comply with NYSDEC Soil Cleanup Objectives (Part 375). There are no location- or action-specific ARARs.	Alternative S-2 would comply with chemical-specific ARARs for soil including NYSDEC Soil Cleanup Objectives for Commercial Use (10 NYCRR Part 375-6 and action-specific ARARs for the management and characterization of contaminated wastes on site. There are no location-specific ARARs.	Same as Alternative S-2.	The same chemical- and action-specific ARARs as Alternative S-2. Additionally, this alternative would comply with federal action-specific ARARs for Underground Injection Control (UIC) (40 C.F.R. 144.81 and .82).	Same as Alternative S-4.	Similar to Alternative S-4, except that the solvent would also need to be managed in accordance with 40 C.F.R. 112.3 to .6 and NYCRR Parts 615.8 to .14.	Same as Alternative S-2.	Same as Alternative S-2.
Long-term Effectiveness and Permanence	Alternative S-1 is not effective in the long-term. Direct contact, erosion, and leaching risks from approximately 7,500 pounds of PCBs and other COCs in approximately 144,000 cubic yards of contaminated soil would remain, without barriers or restrictions in place. Residual PCB concentrations exceed 50 mg/kg.	Alternative S-2 would be moderately effective in the long term. Potential exposure to approximately 6,100 pounds of PCBs and other COCs in approximately 130,000 cubic yards of contaminated soil would be controlled through the cover and LUCs. Residual PCB concentrations exceed 50 mg/kg. The LUCs and cover would be adequate and reliable. Residuals could continue to impact groundwater for an extended period of time.	Similar to Alternative S-2, except the RCRA Cap would further reduce the potential for continued impact to groundwater. Potential exposure to approximately 6,400 pounds of PCBs and other COCs in approximatey 137,000 cubic yards of contaminated soil would be controlled through the cap and LUCs.	Similar to Alternative S-3, except that potential impacts to groundwater from saturated soil would be further reduced.	Similar to Alternative S-4, except untreated soils would be limited to those with PCBs less than 50 mg/kg.	Similar to Alternative S-3, except that potential exposure to approximately 3,300 pounds of PCBs and other COCs in approximately 68,000 cubic yards of contaminated soil would be controlled through the cap and LUCs. PCB-contaminated soil with more than 50 mg/kg would be treated to reduce concentrations by approximately 80 to 90 percent.	Simlar to Alternative S-2, except that potential exposure to 1,100 pounds of PCBs and other COCs in approximately 71,100 cubic yards of contaminated soil would be controlled through the cover and LUCs. Residual PCB concentrations would be less than 10 mg/kg.	There would be no residual contaminated soil at the site.

Criteria	Alternative S-1: No Action	Alternative S-2: Permeable Cover, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), and LUCs	Alternative S-3: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), and LUCs	Alternative S-4: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barriers, and LUCs	Alternative S-5A: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solidifcation of PCB-Contaminated Soil (Greater than 50 mg/kg), and LUCs	Alternative S-5B: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solvent Extraction of PCB-Contaminated Soil (Greater than 50 mg/kg), and LUCs	Alternative S-6: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), Soil Cover, and LUCs	Alternative S-7: Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 1 mg/kg)
Reduction of Toxicity, Mobility or Volume through Treatment	There would be no reduction in toxicity, mobility or volume through treatment. Pesticide, SVOC, VOC, and hexavalent chromium concentrations would slowly attenuate naturally. PCBs and other metals would remain indefinitely.	There would be no reduction in toxicity, mobility, or volume through treatment. Pesticide, SVOC, VOC, and hexavalent chromium concentrations would slowly attenuate naturally. PCBs and other metals would remain indefinitely. Approximately 1,400 pounds of PCBs in 14,000 cubic yards would be removed via excavation and offsite disposal.	Similar to Alternative S-2, except that approximately 1,100 pounds of PCBs in 7,000 cubic yards would be removed via excavation and offsite disposal.	Same as Alternative S-3.	Approximately 16,000 cubic yards of contaminated soil would be treated by solidification to encapsulate approximately 3,300 pounds of PCBs to limit mobility. COC attenuation and excavation and offsite disposal would be the same as Alternative S-3.	Approximately 76,000 cubic yards of contaminated soil would be treated by solvent extraction to remove aprpoximately 4,200 pounds of PCBs to limit mobility. Approximatley 740,000 gallons of waste solvent would be generated for offsite disposal or onsite treatment and reuse. COC attenuation and excavation and offsite disposal would be the same at Alternative S-3.	Similar to Alternative S-2, except that approximately 6,400 pounds of PCBs in 73,000 cubic yards would be removed via excavation and offsite disposal.	Similar to Alternative S-2, except that approximately 7,500 pounds of PCBs in 144,000 cubic yards would be removed via excavation and offsite disposal.
Short-term Effectiveness	Because there is no action being taken, Alternative S-1 would be effective in the short-term.	Alternative 2 would be effective in the short term. A portion of the excavation may extend beyond the fenceline to the east into the residential neighborhood. There is a potential for COC-contaminated dust being generated during excavation and loading activities, which would need to be adressed through monitoring and dust-supression procedures. Monitoring and PPE would be used to protect workers during implementation. This remedy could be implemented within 5 years after signing the ROD.	Similar to Alternative S-2, except that the remedy would be implemented within 6 years after signing the ROD.	Similar to Alternative S-3, except that the remedy would be implemented within 7 years after signing the ROD, and an additional 3,500 cubic yards of waste material from the vertical barriers would need to be handled.	Similar to Alternative S-4, except that the remedy would be implemented within 8 years after signing the ROD.	Similar to Alternative S-4, except that the remedy would be implemented within 11 years after signing the ROD.	Similar to Alternative S-2, except that the remedy would be implemented within 7 years after signing the ROD.	Similar to Alternative S-2, except that the remedy would be implemented with 10 years after signing the ROD.
Implementability	This is no activity to implement.	Alternative S-2 employs a technically straight forward approach and no permits are required. Vendors are readily available to conduct this work.	Same as Alternative S-2.	Similar to Alternative S-2, except the installation of vertical barriers is a less common practice, but vendors are available.	The same as Alternative S-4.	Most of the elements are similar to Alternative S-4. The solvent extraction step is innovative and would need to be developed specifically for this site.	Similar to Alternative S-2, except that the excavation would be very deep and extend below the water table.	Same as Alternative S-6.
Cost	$0	Capital: $12,900,000 O&M: $12,800 to $43,000 per year over 30 years. PV: $13,400,000	Capital: $14,600,000 O&M: $12,800 to $43,000 per year over 30 years. PV: $15,000,000	Capital: $24,000,000 O&M: $12,800 to $43,000 per year over 30 years. PV: $24,500,000	Capital: $23,600,000 O&M: $12,800 to $43,000 per year over 30 years. PV: $24,000,000	Capital: $41,900,000 O&M: $12,800 to $140,000 per year over 30 years. PV: $42,800,000	Capital: $60,100,000 O&M: $12,800 to $43,000 per year over 30 years. PV: $60,600,000	Capital: $99,700,000 O&M: $0 PV: $99,700,000

1 - State and Community Acceptance are to be determined based on a review of this FS and development of a Proposed Plan and Statement of Basis.

NYSDEC - New York State Department of Environmental Conservation.
RCRA - Resource Conservation and Recovery Act.
ARARs - Applicable or Relevant and Appropriate Requirements.
NYCRR - New York Codes, Rules, and Regulations.
PPE- Personal Protective Equipment.
mg/kg - milligram per kilogram.
LUC - Land Use Controls.
PV - Present Value.
PCB- Polychlorinated Biphenyl.
ROD - Record of Decision.
COC- Contaminant of Concern.
PRGs - Preliminary Remediation Goals.
O & M - Operation and maintenance.

TABLE 5-3
COMPARATIVE ANALYSIS OF SOIL VAPOR ALTERNATIVES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Criteria	Alternative SV-1: No Action (Shut Down of SVEC System)	Alternative SV-2: Soil Vapor Monitoring, LUCs, and Continued Operation of the SVE Containment System	Alternative SV-3: Soil Vapor Monitoring, LUCs, Continued Operation of the SVE Containment System, and Enhanced Soil Vapor Extraction at Site 1
Overall Protection of Human Health and the Environment	Not protective of human health and the environment. Existing site vapors could migrate off property and result in vapor intrusion risks. If new structures are constructed on site, there would be no provision for notifying, testing, or implementing vapor intrusion mitigation.	Continued operation of the SVE Containment System and monitoring would protect off property residents. LUCs would require that vapor intrusion concerns be considered for any new onsite structures.	Similar to Alternative SV-2, except that the installation of additional SVE wells in the source area would be considered to enhance VOC removal and decrease the time required for operation of the SVE Containment System and LUCs.
Compliance with ARARs	There are no ARARs for Alternative SV-2. This alternative would not comply with NYSDOH Soil Vapor Instrusion Guidance (NYSDOH 2006) .	Alternative SV-2 would comply with action specific ARARs for the control and prevention of air pollutants (6 NYCRR 212.9) through the use of off gas treatment as required and the chemical-specific NYSDOH Soil Vapor Intrusion Guidance.	Same as Alternative SV-2.
Long-term Effectiveness and Permanence	Not effective in the long-term. Soil vapors would result in a continuing potential risk to off site properties, and if constructed, on property structures could be impacted by vapor intrusion.	Alternative SV-2 would be protective and permanent in the long term. Analytical and vacuum monitoring provides redundent confirmation of effectiveness. Eventually, the VOCs will be purged and the containment system shut down and the LUCs removed.	Same as Alternative SV-2.
Reduction of Toxicity, Mobility or Volume through Treatment	There would be no reduction in toxicity, mobility, or volume through treatment.	Approximately 12 pounds of TCE and PCE are removed per year and treated with vapor phase granular activited carbon prior to discharge to the atmosphere. The carbon will be taken offsite for disposal or regeneation.	Similar to Alternative SV-2, except that higher quantities of VOCs would be removed initially.

TABLE 5-3
COMPARATIVE ANALYSIS OF SOIL VAPOR ALTERNATIVES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Criteria	Alternative SV-1: No Action (Shut Down of SVEC System)	Alternative SV-2: Soil Vapor Monitoring, LUCs, and Continued Operation of the SVE Containment System	Alternative SV-3: Soil Vapor Monitoring, LUCs, Continued Operation of the SVE Containment System, and Enhanced Soil Vapor Extraction at Site 1
Short-term Effectiveness	Since there are no activities, there would be no short term risks.	LUCs, in combination with monitoring and operation and maintenance of the SVE containment system, would be protective while contamination remains. Depending on the soil remedy, vapors could require treatment for an extended time period (i.e., greater than 30 years).	Similar to Alternative SV-2, except that the remedy should be completed sooner. Additional source area treatment would reduce the time of operation for the SVEC system.
Implementability	Since there are no activities, there would no implementation concerns.	Since there are no additional activities, there would no implementation concerns. Permits are not required.	The infrastructure to the SVEC system is already in place, and vendors and operators are available to add additional SVE wells for source area treatment.
Cost	$0	Capital: $0 O&M: $100,000 to 115,000 per year over 30 years. PV: $2,600,000	Capital: $ 220,000 O&M: $ 110,000 to 125,000 per year over 15 years. PV: $1,700,000

1 - State and Community Acceptance are to be determined based on a review of this FS/CMS and development of a Proposed Plan and Statement of Basis.

O & M - Operation and maintenance.
ARARs - Applicable or Relevant and Appropriate Requirements.
RAOs - Remedial Action Objectives.
PV - Present value.
VOC - Volatile Organic Compound.
TCE - Trichloroethene.
PCE - Tetrachloroethene
SVE - Soil Vapor Extraction

LUCs - Land Use Controls
NYSDOH - New York State Department of Health
NYCRR - New York Code, Rules, and Regulations

TABLE 5-4
COMPARATIVE ANALYSIS OF GROUNDWATER ALTERNATIVES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Criteria	Alternative G-1: No Action	Alternative G-2: Monitoring and LUCs	Alternative G-3A: Monitoring, LUCs, and Upgrade of the ONCT System with GAC Treatment	Alternative G-3B: Monitoring, LUCs, and Upgrade of the ONCT System with Ion Exchange Treatment
Overall Protection of Human Health and the Environment	Not protective of human health and the environment. Groundwater could be extracted and used as a potable water supply. Although there are current restrictions on the use of VOC-impacted groundwater, these restrictions do not apply to PCB- and metal-contaminated groundwater. In addition, if this contaminanted groundwater reaches the on-site containment (ONCT) system, it would pass through the system and be discharged through recharge basins and potentially impact downgradient water supplies.	The alternative would be protective of human health and the environment. Monitoring and LUCs would be used to track contaminant migration and attenuation and prohibit potable use of the groundwater. If PCBs and metals are intercepted by the ONCT without sufficient attenuation, the system may need to be shut down to protect downgradient groundwater.	Similar to Alternative G-2, except that this alternative would also provide granular activated carbon treatment of ONCT water to remove PCBs prior to discharge.	Similar to Alternative G-2, except that this alternative would also provide ion exchange treatment of ONCT water to remove metals prior to discharge.
Compliance with ARARs	Does not comply with state chemical-specific ARARs for drinking water, NYSDOH MCLs for drinking water (equivalent to USEPA Safe Drinking Water Act MCLs) (10 NYCRR Part 5-1: 5-1.52).	Would comply with the chemical-specific ARARs, including NYSDOH MCLs for drinking water (equivalent to USEPA Safe Drinking Water Act MCLs) (10 NYCRR Part 5-1: 5-1.52), state regulations for a sole-source drinking water aquifer (6 NYCRR Parts 701.15 and 702.3) and location-specific ARAR for the Safe Drinking Water Act sole-source drinking water aquifer (40 C.F.R. 149.3).	Same as Alternative G-2.	Same as Alternative G-2.
Long-term Effectiveness and Permanence	Alternative G-1 would not be protective in the long-term. PCBs and metals in groundwater exceed PRGs, and if ingested, pose a risk to human health. There would be no controls in place to monitor potential effects of groundwater use or determine impacts to the ONCT system. If PCB- or metals-contaminated groundwater migrates and impacts the ONCT system, the system would need to be shut down or upgraded. PCBs and metals are present in concentrations greater than PRGs and would remain in groundwater for an extended time.	Alternative G-2 would be protective and permanent in the long term. Contaminants would move slowly through the aquifer and concentrations would decrease naturally with time and distance. There is a potential that contaminants could impact the ONCT and cause it to shut down.	Similar to Alternative G-2, except this alternative provides a contingency in the event that the PCBs do not attenuate sufficiently prior to capture by the ONCT System.	Similar to Alternative G-2, except this alternative provides a contingency in the event that the metals do not attenuate sufficiently prior to capture by the ONCT System.
Reduction of Toxicity, Mobility or Volume through Treatment	There would be no reduction of toxicity, mobility, or volume through treatment. Residual groundwater contamination would degrade through natural mechanisms, including adsorption, chemical reduction, and abiotic degradation. Contaminated groundwater could remain for an extended time period.	Same as Alternative G-1.	If PCBs reach the ONCT System at concentrations that require treatment, then granular activated carbon would be used to remove them. The carbon would then be disposed or regenerated offsite.	Similar to Alternative G-3A, except that if metals reach the ONCT System at concentrations that would require treatment, then an ion exchange resin would be used to remove them. The ion exchange resin would then be disposed offsite.

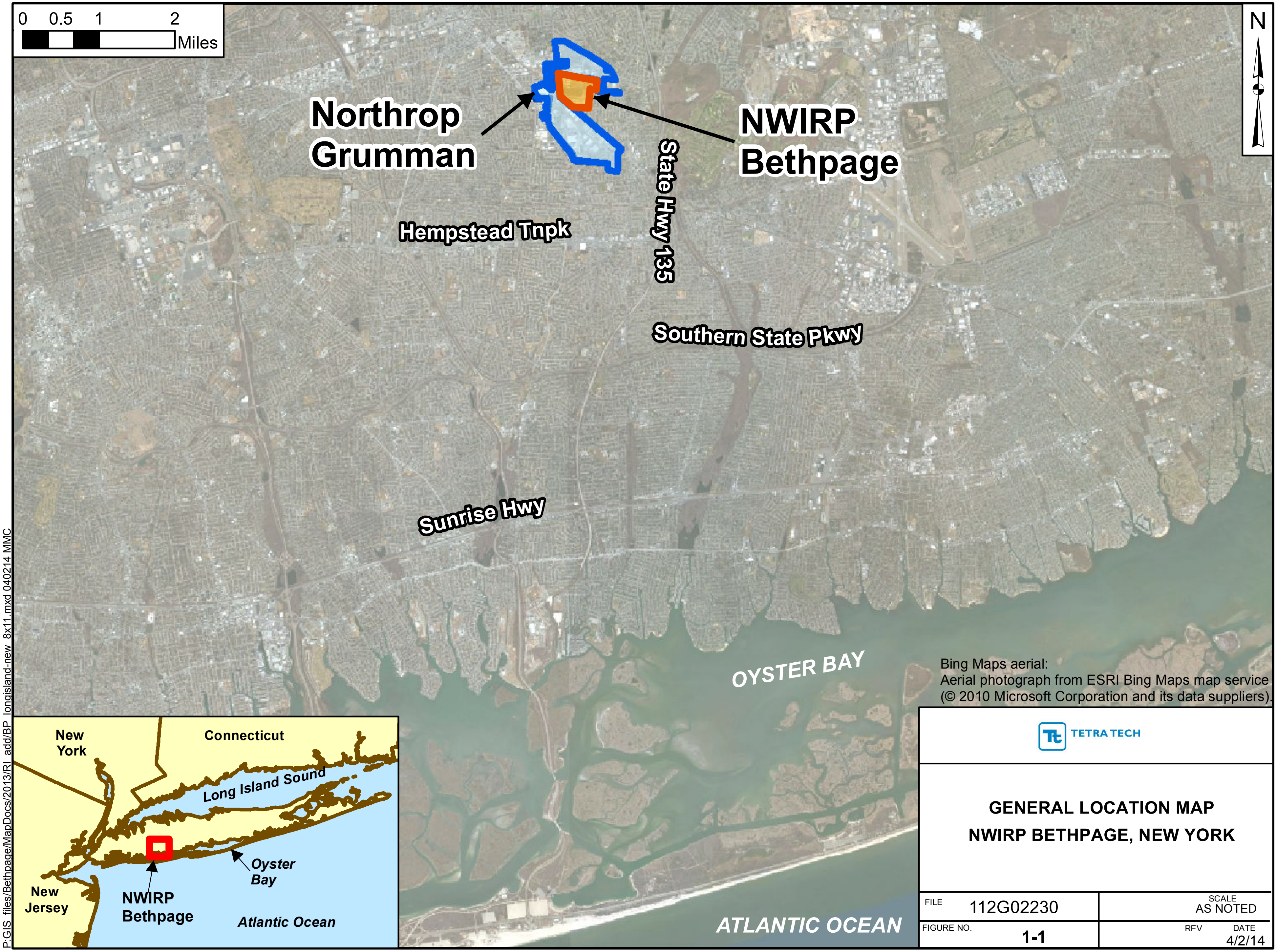
TABLE 5-4
COMPARATIVE ANALYSIS OF GROUNDWATER ALTERNATIVES
SITE 1 - FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

Criteria	Alternative G-1: No Action	Alternative G-2: Monitoring and LUCs	Alternative G-3A: Monitoring, LUCs, and Upgrade of the ONCT System with GAC Treatment	Alternative G-3B: Monitoring, LUCs, and Upgrade of the ONCT System with Ion Exchange Treatment
Short-term Effectiveness	Since there are no activities, there would be no short term risks.	LUCs, in combination with monitoring, would be protective while contamination remains. However, if PCB- or metals-contaminated groundwater migrates to the ONCT system, the system would require shut down. The LUCs and monitoring would be required for an extended time period (i.e., greater than 30 years). Actions that would address a continuing source of contaminants would decrease the risk of impact to the ONCT.	Same as Alternative S-2.	Same as Alternative S-2.
Implementability	Easy to implement.	Easy to implement. Resources are available to operate the existing monitoring network, including the installation of additional monitoring wells.	Same as Alternative G-2. The infrastructure to the ONCT system is already in place, and vendors and operators are available to deliver and install an upgrade (GAC) to the system.	Same as Alternative G-2. The infrastructure to the ONCT system is already in place, and vendors and operators are available to deliver and install an upgrade (e.g., ion exchange resin) to the system.
Cost	$0	Capital: $230,000 O&M: $96,000 to $111,000 per year over 30 years PV: $2,600,000	Capital: $3,100,000 O&M: $153,000 to $168,000 per year over 30 years PV: $6,900,000	Capital: $2,200,000 O&M: $550,000 to $565,000 per year over 30 years PV: $15,800,000

Notes

O & M - Operation and maintenance
ARARs - Applicable, Relevant, and Appropriate Requirements
PRGs - Preliminary Remediation Goals
PV - Present value
PCB - Polychlorinated Biphenyl
VOC - Volatile Organic Compound
ONCT - On-site Containment System
GAC - Granular Activated Carbon

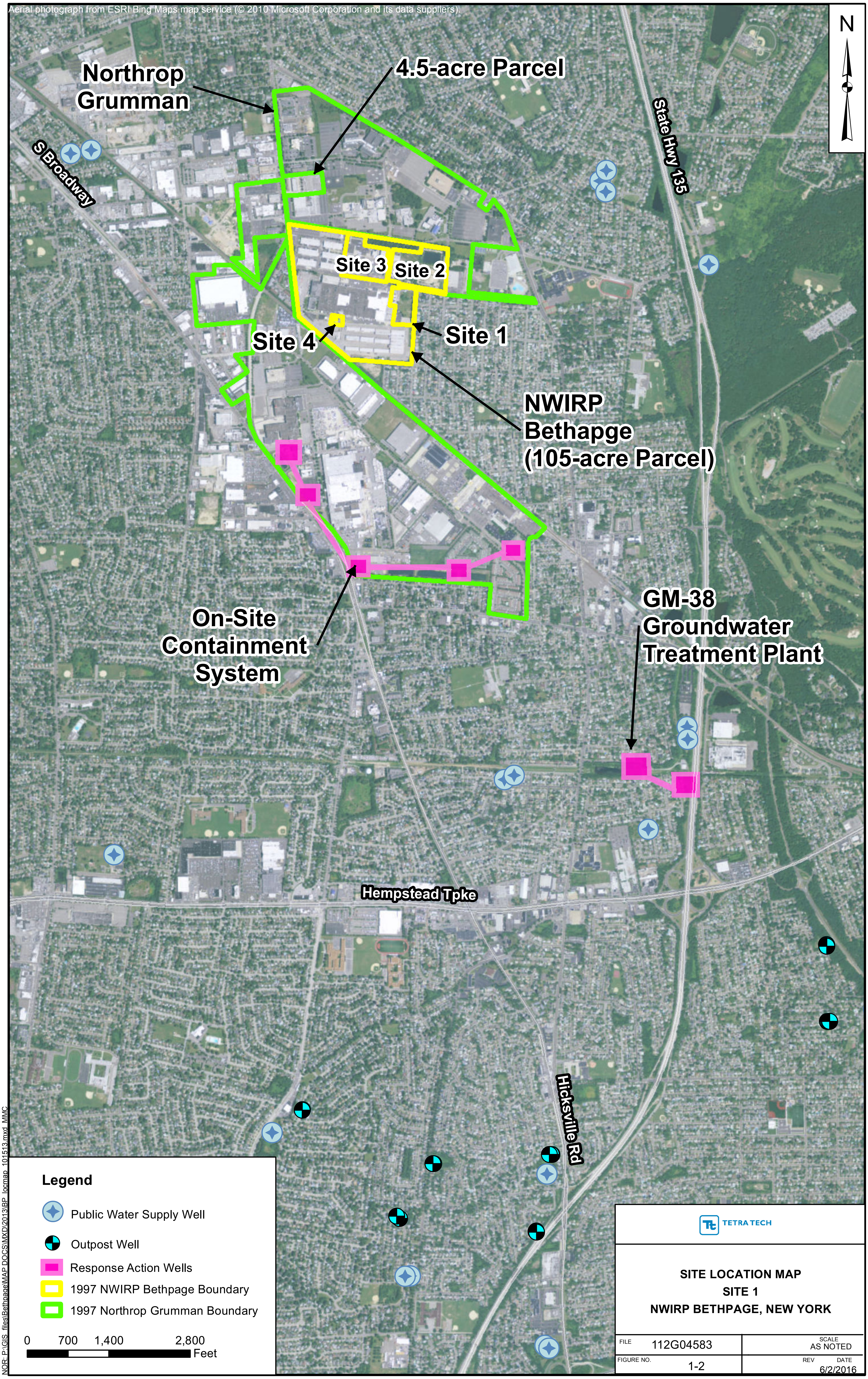
1 - State and Community Acceptance are to be determined based on a review of this FS/CMS and development of a Proposed Remedial Action Plan and Statement of Basis.



GENERAL LOCATION MAP
NWIRP BETHPAGE, NEW YORK

FILE 112G02230	SCALE AS NOTED
FIGURE NO. 1-1	REV DATE 4/2/14

P:GIS files/Bethpage/MapDocs/2013/RI add/BP longisland-new 8x11.mxd 040214 MMC


Aerial photograph from ESRI Bing Maps map service (© 2010 Microsoft Corporation and its data suppliers).
N
Northrop Grumman
4.5-acre Parcel
S Broadway
State Hwy 135
Site 3
Site 2
Site 1
Site 4
NWIRP Bethapge (105-acre Parcel)
On-Site Containment System
GM-38 Groundwater Treatment Plant
Hempstead Tpke
Hicksville Rd
Legend
Public Water Supply Well
Outpost Well
Response Action Wells
1997 NWIRP Bethpage Boundary
1997 Northrop Grumman Boundary
0 700 1,400 2,800
Feet
NOR P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\BP_locmap_101513.mxd MMC
TETRA TECH
SITE LOCATION MAP
SITE 1
NWIRP BETHPAGE, NEW YORK
FILE
112G04583
SCALE
AS NOTED
FIGURE NO.
1-2
REV
DATE
6/2/2016

SITE 1
FORMER DRUM MARSHALLING AREA
LAYOUT MAP
NWIRP BETHPAGE, NEW YORK

FILE 112G02230 | SCALE AS NOTED
FIGURE NO. 2-1 | REV | DATE 4/2/14

P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\RI_add\SITE1_LAYOUT-021714 MMC 040214

Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
NYSDEC- New York State Department of Environmental Conservation
PCB- polychlorinated biphenyl

Isoconcentration shows exceedance of Project Remediation Goals (PRGs) for soil of 1 mg/kg.

NYSDEC Soil Criteria for Protection of Public health Industrial use for Cadmium is 60 mg/kg.

Legend

- Soil Boring Location
- Cadmium ≥ 60 mg/kg
- PCBs ≥ 1 mg/kg

0 50 100 Feet

TETRA TECH

Isoconcentration Contour Map
0 to 2 Feet BGS
PCBs greater than 1 mg/kg
NWIRP Bethpage, New York

FILE 112G05702	SCALE AS NOTED
FIGURE NO. 2-2	REV DATE 7/15/15

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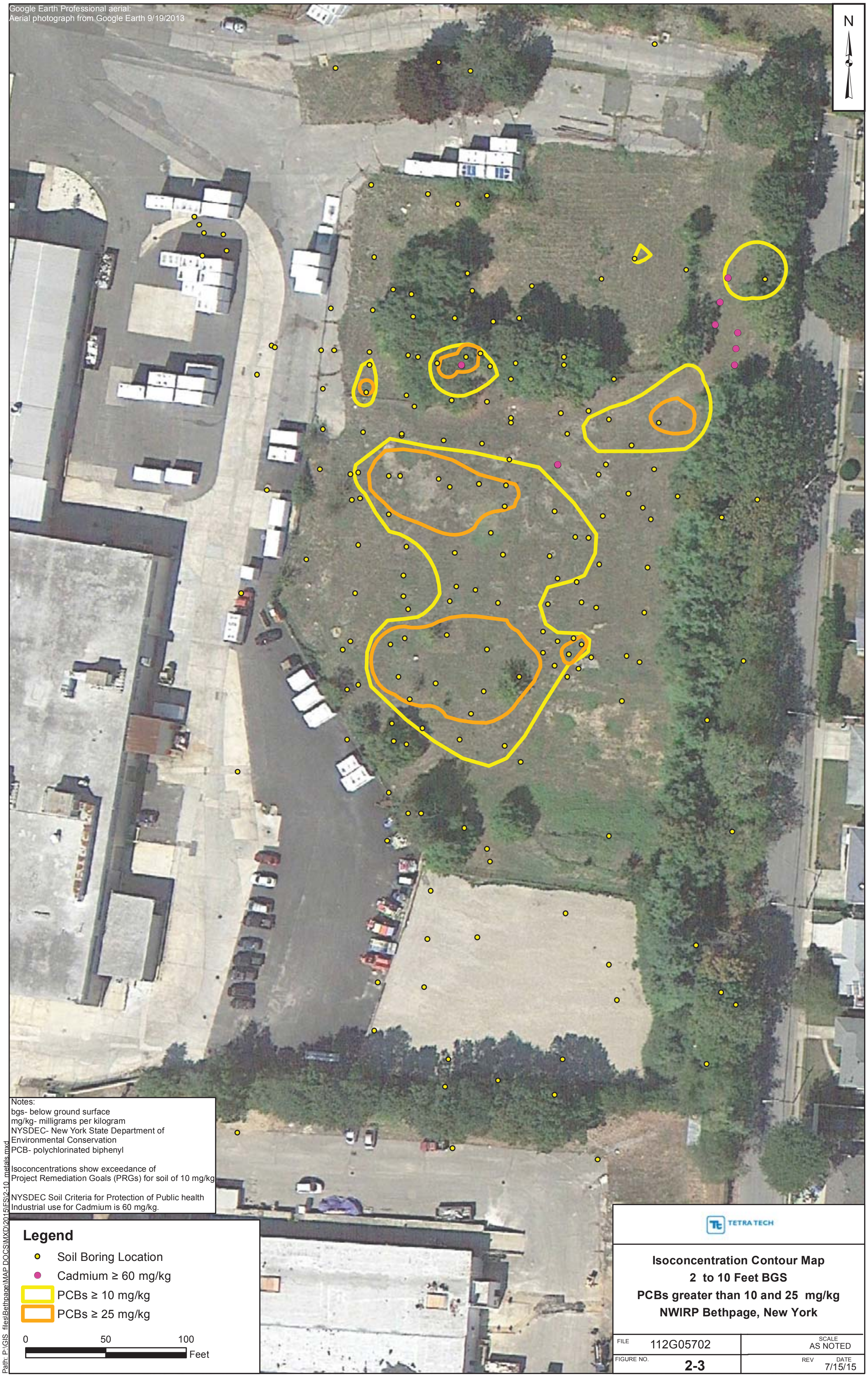
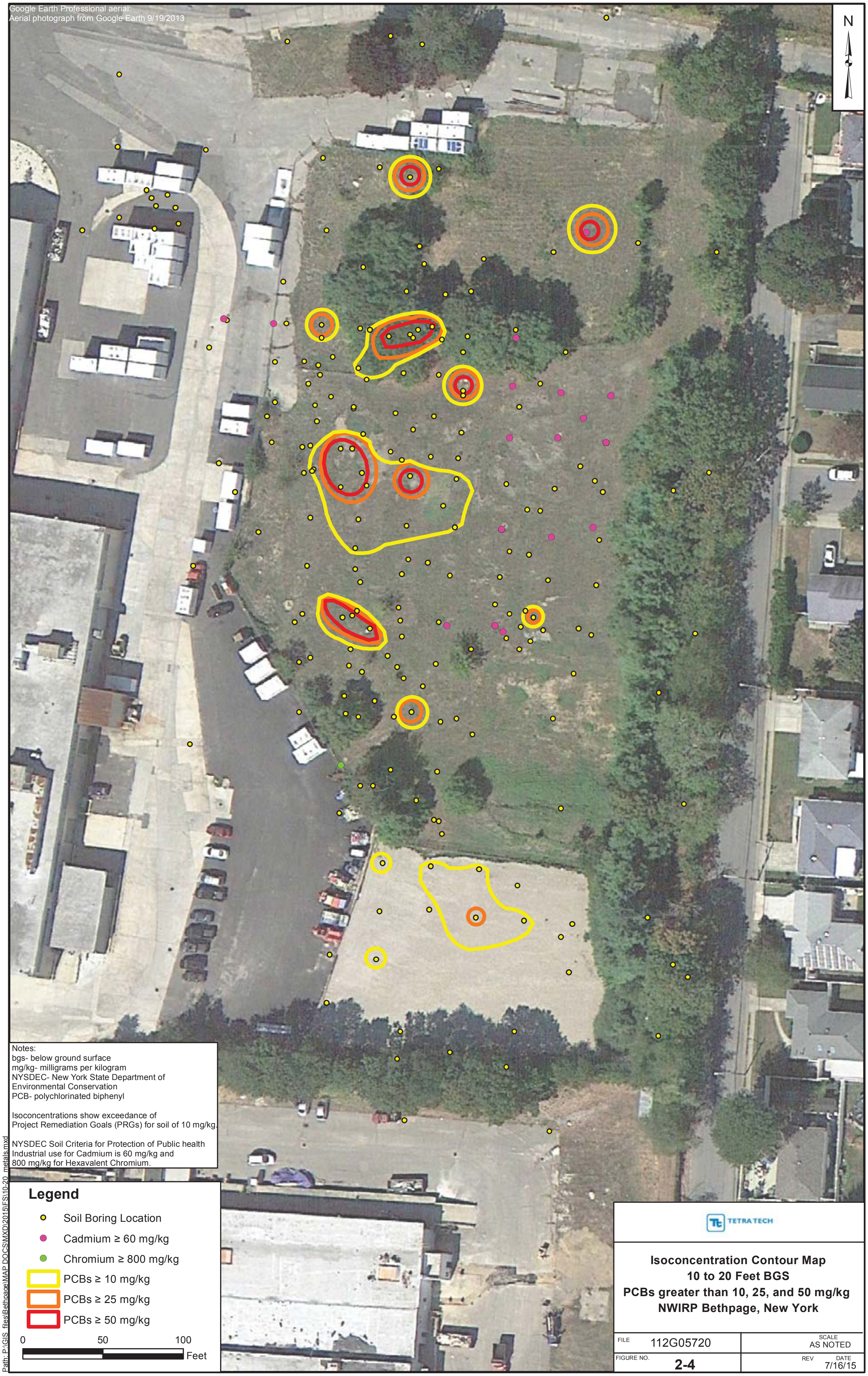


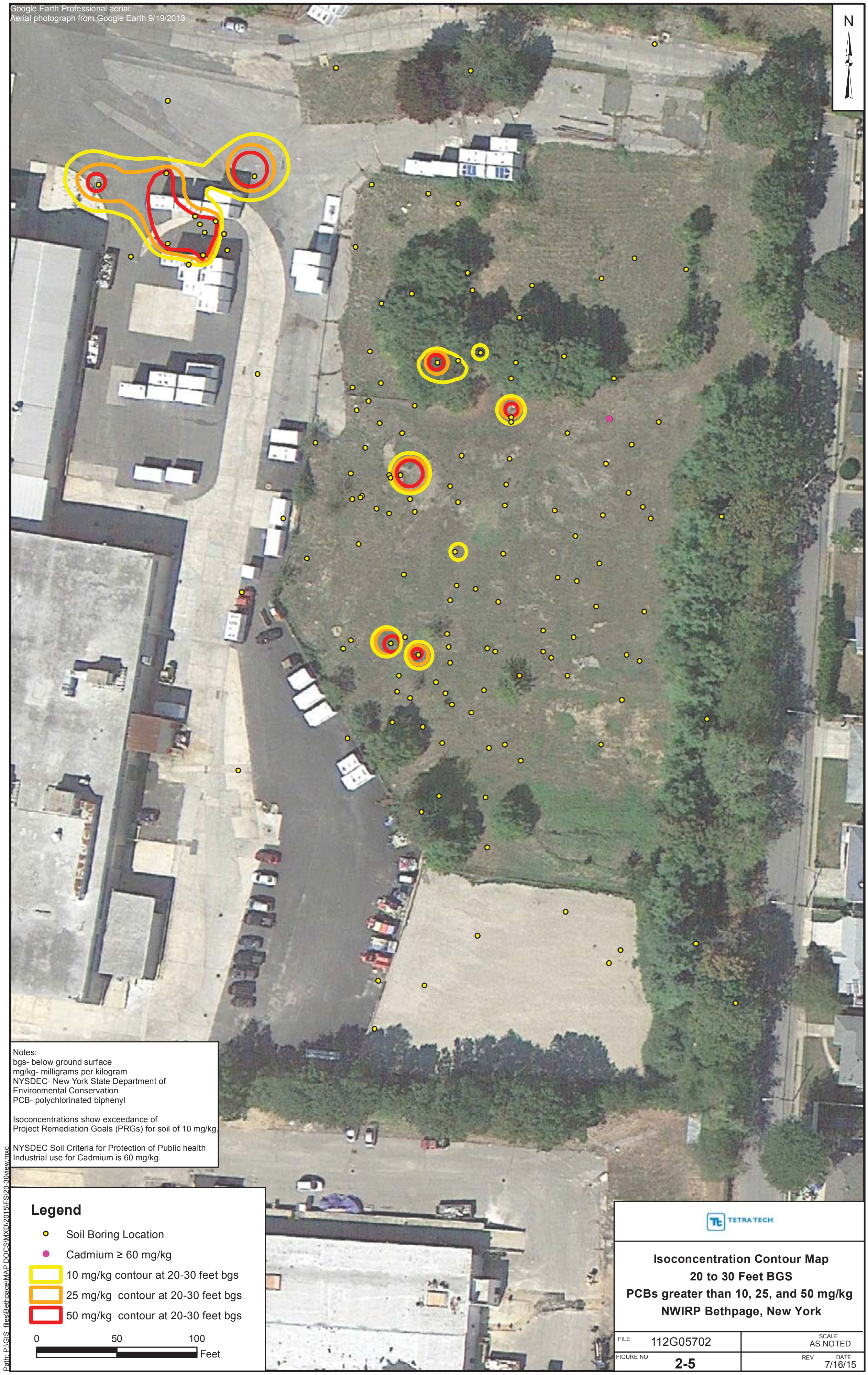
Google Earth Professional aerial:
Aerial photograph from Google Earth 9/19/2013
N
Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
NYSDEC- New York State Department of Environmental Conservation
PCB- polychlorinated biphenyl
Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg
NYSDEC Soil Criteria for Protection of Public health Industrial use for Cadmium is 60 mg/kg.
Legend
Soil Boring Location
Cadmium ≥ 60 mg/kg
PCBs ≥ 10 mg/kg
PCBs ≥ 25 mg/kg
0
50
100
Feet
Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\2-10_metals.mxd
TETRA TECH
Isoconcentration Contour Map
2 to 10 Feet BGS
PCBs greater than 10 and 25 mg/kg
NWIRP Bethpage, New York
FILE
112G05702
SCALE
AS NOTED
FIGURE NO.
2-3
REV
DATE
7/15/15



TETRA TECH

Isoconcentration Contour Map
10 to 20 Feet BGS
PCBs greater than 10, 25, and 50 mg/kg
NWIRP Bethpage, New York

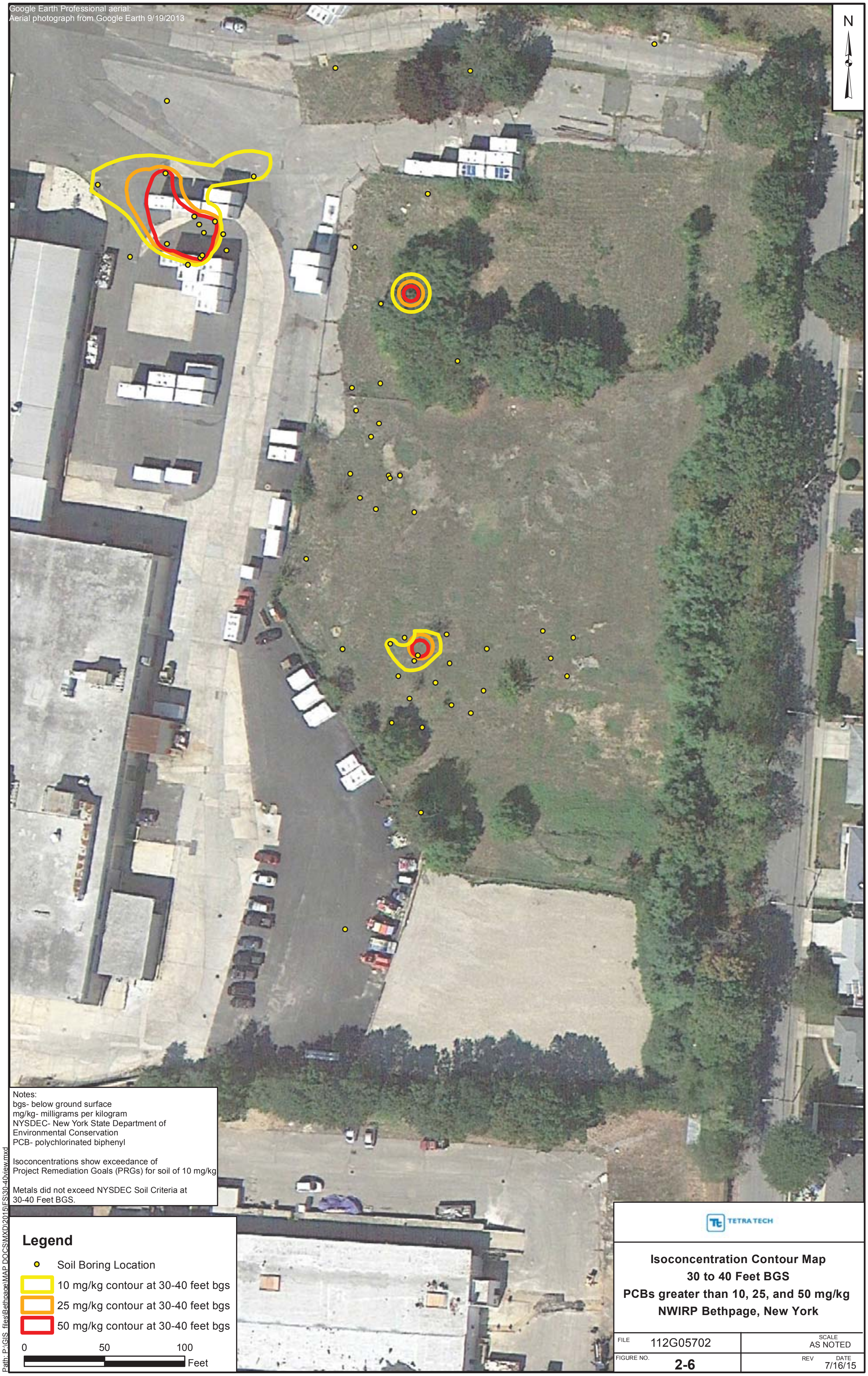
FILE	SCALE
112G05720	AS NOTED
FIGURE NO. **2-4**	REV DATE 7/16/15

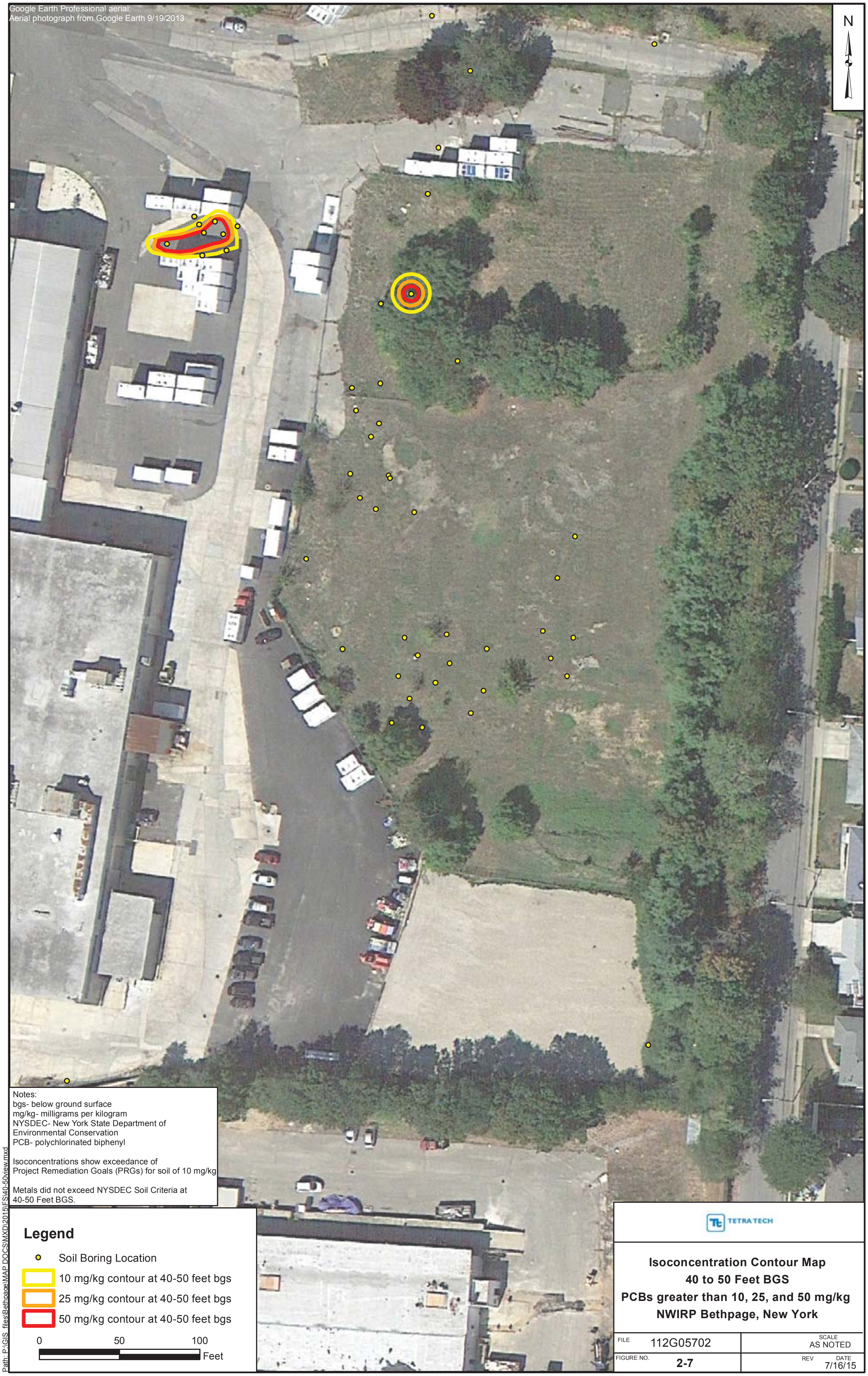


TETRA TECH

Isoconcentration Contour Map
20 to 30 Feet BGS
PCBs greater than 10, 25, and 50 mg/kg
NWIRP Bethpage, New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	**2-5**	REV	DATE 7/16/15


Google Earth Professional aerial:
Aerial photograph from Google Earth 9/19/2013
N
Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
NYSDEC- New York State Department of Environmental Conservation
PCB- polychlorinated biphenyl
Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg
Metals did not exceed NYSDEC Soil Criteria at 30-40 Feet BGS.
Legend
Soil Boring Location
10 mg/kg contour at 30-40 feet bgs
25 mg/kg contour at 30-40 feet bgs
50 mg/kg contour at 30-40 feet bgs
0
50
100
Feet
Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\30-40view.mxd
TETRA TECH
Isoconcentration Contour Map
30 to 40 Feet BGS
PCBs greater than 10, 25, and 50 mg/kg
NWIRP Bethpage, New York
FILE
112G05702
SCALE
AS NOTED
FIGURE NO.
2-6
REV
DATE
7/16/15



Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
NYSDEC- New York State Department of Environmental Conservation
PCB- polychlorinated biphenyl

Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg

Metals did not exceed NYSDEC Soil Criteria at 40-50 Feet BGS.

Legend

- Soil Boring Location
- 10 mg/kg contour at 40-50 feet bgs
- 25 mg/kg contour at 40-50 feet bgs
- 50 mg/kg contour at 40-50 feet bgs

0 50 100 Feet

TETRA TECH

Isoconcentration Contour Map
40 to 50 Feet BGS
PCBs greater than 10, 25, and 50 mg/kg
NWIRP Bethpage, New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	2-7	REV	DATE 7/16/15

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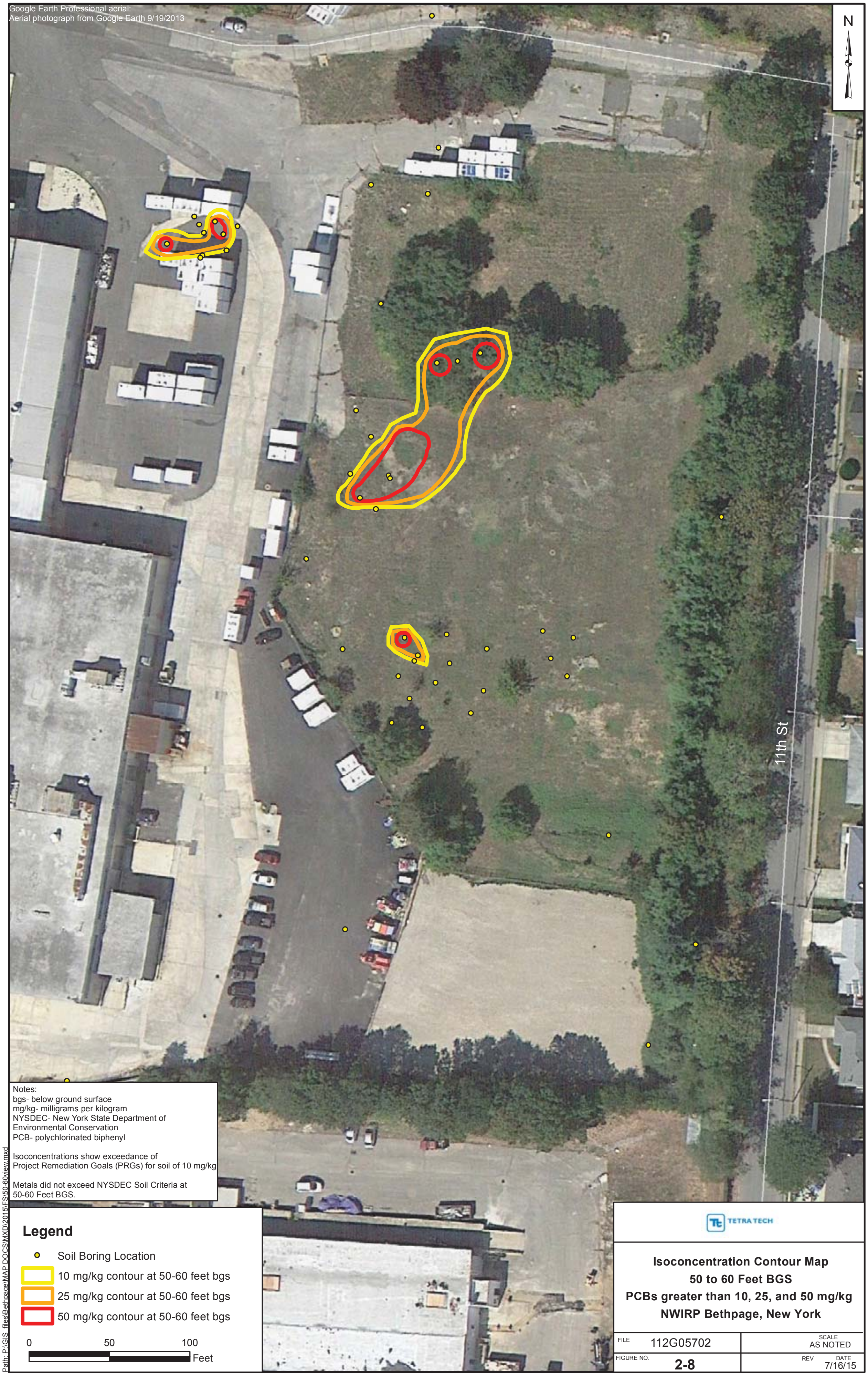

Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
NYSDEC- New York State Department of Environmental Conservation
PCB- polychlorinated biphenyl

Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg

Metals did not exceed NYSDEC Soil Criteria at 50-60 Feet BGS.

Legend

- Soil Boring Location
- 10 mg/kg contour at 50-60 feet bgs
- 25 mg/kg contour at 50-60 feet bgs
- 50 mg/kg contour at 50-60 feet bgs

TETRA TECH

Isoconcentration Contour Map
50 to 60 Feet BGS
PCBs greater than 10, 25, and 50 mg/kg
NWIRP Bethpage, New York

FILE 112G05702	SCALE AS NOTED
FIGURE NO. **2-8**	REV DATE 7/16/15

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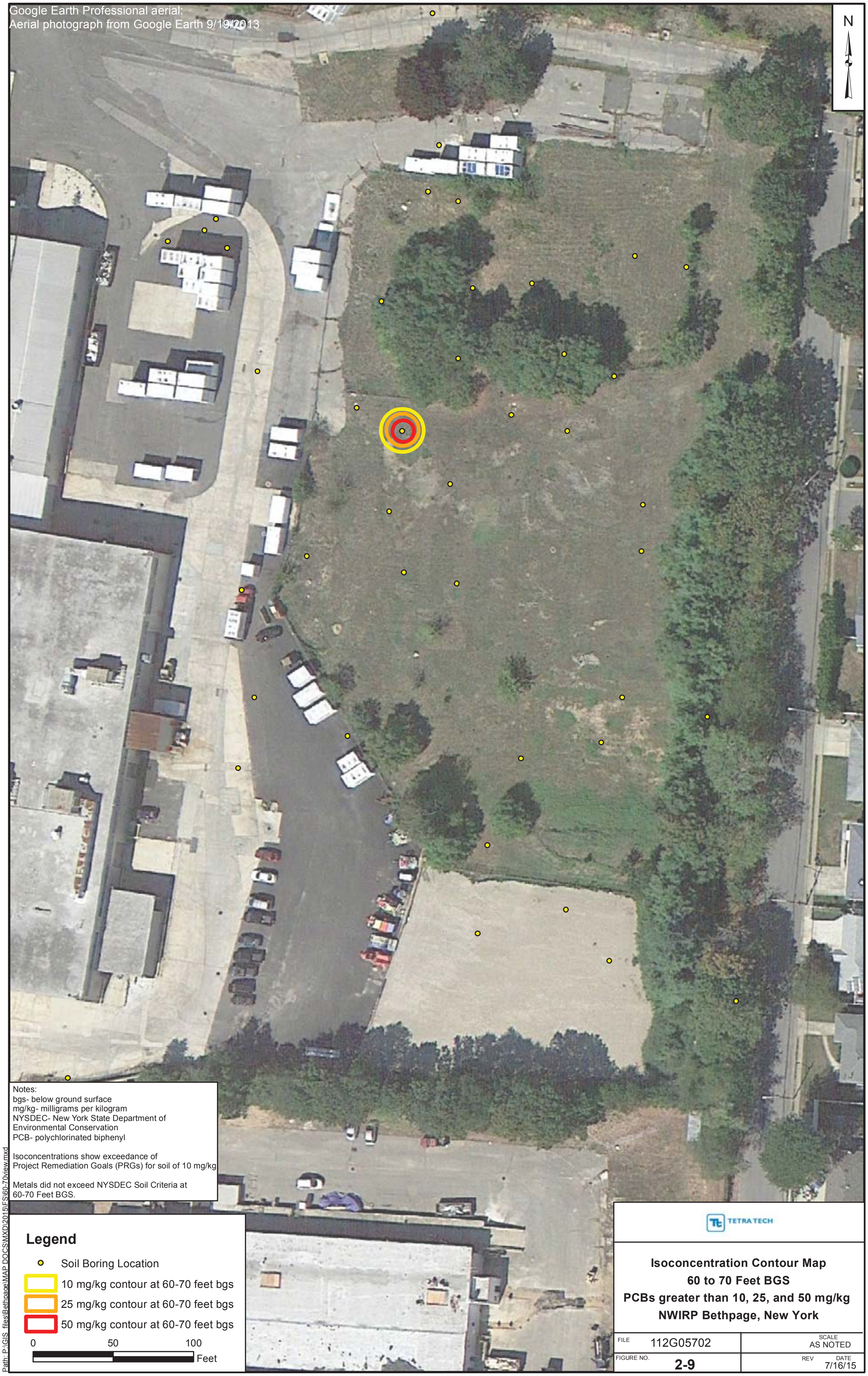

TETRA TECH

Isoconcentration Contour Map
60 to 70 Feet BGS
PCBs greater than 10, 25, and 50 mg/kg
NWIRP Bethpage, New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	2-9	REV	DATE 7/16/15

Legend

- Dry Well
- Soil Boring
- Historical Soil Boring

Total PCB Concentrations 2 to 15 feet bgs

- >10 mg/kg
- >50 mg/kg
- Excavation Area

0 10 20
Feet

Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
PCB- polychlorinated biphenyl

Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg.
*PCB isoconcentrations created from historical soil boring data from the 1990s, 2000s and current data from 2010 to 2013 sample results.
**Dashed lines are inferred

TETRA TECH

PCB Isoconcentration Map
Shallow Subsurface Soil
(2 to 15 Feet BGS)
Dry Well 34-07
NWIRP Bethpage, New York

FILE 112G05702	SCALE AS NOTED
FIGURE NO. **2-10**	REV DATE 7/16/15

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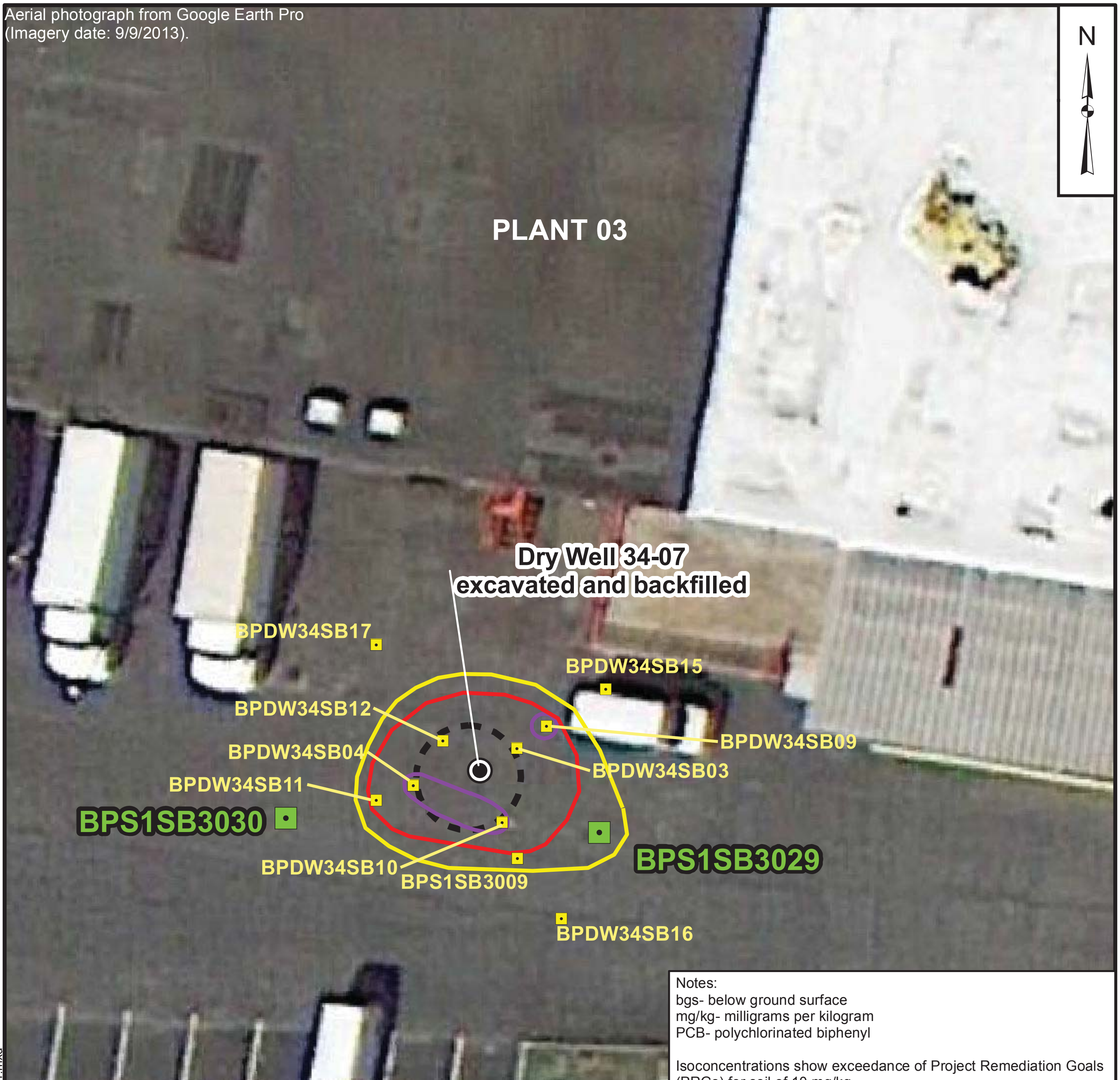

Legend

- Dry Well
- Historical Soil Boring
- Soil Boring

Total PCB Concentrations 15 to 50 feet bgs

- >10 mg/kg
- >50 mg/kg
- >500 mg/kg
- Excavation Area

0 10 20 Feet

Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
PCB- polychlorinated biphenyl

Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg.
*PCB isoconcentrations created from historical soil boring data from the 1990s, 2000s and current data from 2010 to 2013 sample results.
**Dashed lines are inferred

TETRA TECH

PCB Isoconcentration Map
Deep Subsurface Soil
(15 to 50 Feet BGS)
Dry Well 34-07
NWIRP Bethpage, New York

FILE 112G05702	SCALE AS NOTED
FIGURE NO. **2-11**	REV DATE 7/16/15

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\DW3407_deep1.mxd

Notes:
bgs- below ground surface
mg/kg- milligrams per kilogram
PCB- polychlorinated biphenyl

Isoconcentrations show exceedance of Project Remediation Goals (PRGs) for soil of 10 mg/kg.
*PCB isoconcentrations created from historical soil boring data from the 1990s, 2000s and current data from 2010 to 2013 sample results.
**Dashed lines are inferred

Legend

- Dry Well
- Historical Soil Boring
- Soil Boring

Total PCB Concentrations 15 to 50 feet bgs

- >10 mg/kg
- Excavation Area

0 10 20
Feet

TETRA TECH

PCB Isoconcentration Map
Deep Subsurface Soil
(50 to 54 Feet BGS)
Dry Well 34-07
NWIRP Bethpage, New York

FILE 112G05702	SCALE AS NOTED
FIGURE NO. **2-12**	REV DATE 7/16/15

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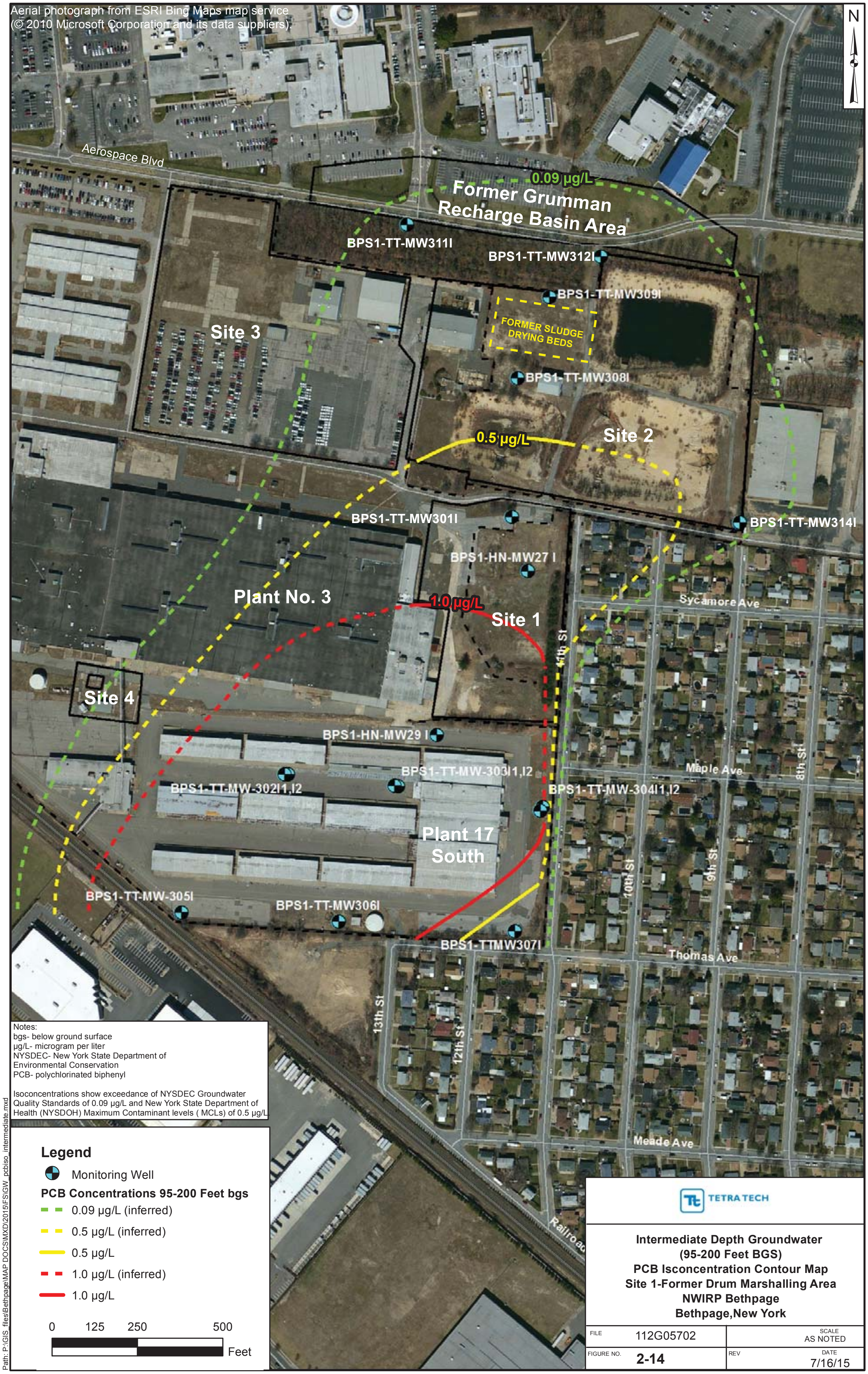


Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\GW_pcbiso_intermediate.mxd

Notes:
bgs- below ground surface
µg/L- microgram per liter
NYSDEC- New York State Department of Environmental Conservation
PCB- polychlorinated biphenyl

Isoconcentrations show exceedance of NYSDEC Groundwater Quality Standards of 0.09 µg/L and New York State Department of Health (NYSDOH) Maximum Contaminant levels (MCLs) of 0.5 µg/L.

Legend

Monitoring Well

PCB Concentrations 180-294 Feet bgs

- 0.09 µg/L
- 0.09 µg/L (inferred)
- 0.5 µg/L
- 0.5 µg/L (inferred)
- 1.0 µg/L
- 1.0 µg/L (inferred)

0 125 250 500 Feet

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\GW_pcbiso_deep.mxd

TETRA TECH

Deep Groundwater (180-294 Feet BGS) PCB Isconcentration Contour Map Site 1-Former Drum Marshalling Area NWIRP Bethpage Bethpage,New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	2-15	REV	DATE 7/16/15

Notes:
bgs- below ground surface
µg/L- microgram per liter

Isoconcentrations show exceedance of New York State Department of Environmental Conservation (NYSDEC) Groundwater Quality Standards of 50 µg/L and New York State Department of Health (NYSDOH) Maximum Contaminant levels (MCLs) of 100 µg/L.

TETRA TECH

Shallow Groundwater (40-67 Feet BGS)
Hexavalent Chromium
Contour Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage
Bethpage, New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	2-16	REV	DATE 7/16/15

Notes:
bgs- below ground surface
µg/L- microgram per liter

Isoconcentrations show exceedance of New York State Department of Environmental Conservation (NYSDEC) Groundwater Quality Standards of 50 µg/L and New York State Department of Health (NYSDOH) Maximum Contaminant levels (MCLs) of 100 µg/L.

Legend

Monitoring Well

Hexavalent Chromium
Concentrations 95-200 feet bgs

50 µg/L inferred
50 µg/L
100 µg/L

0 125 250 500
Feet

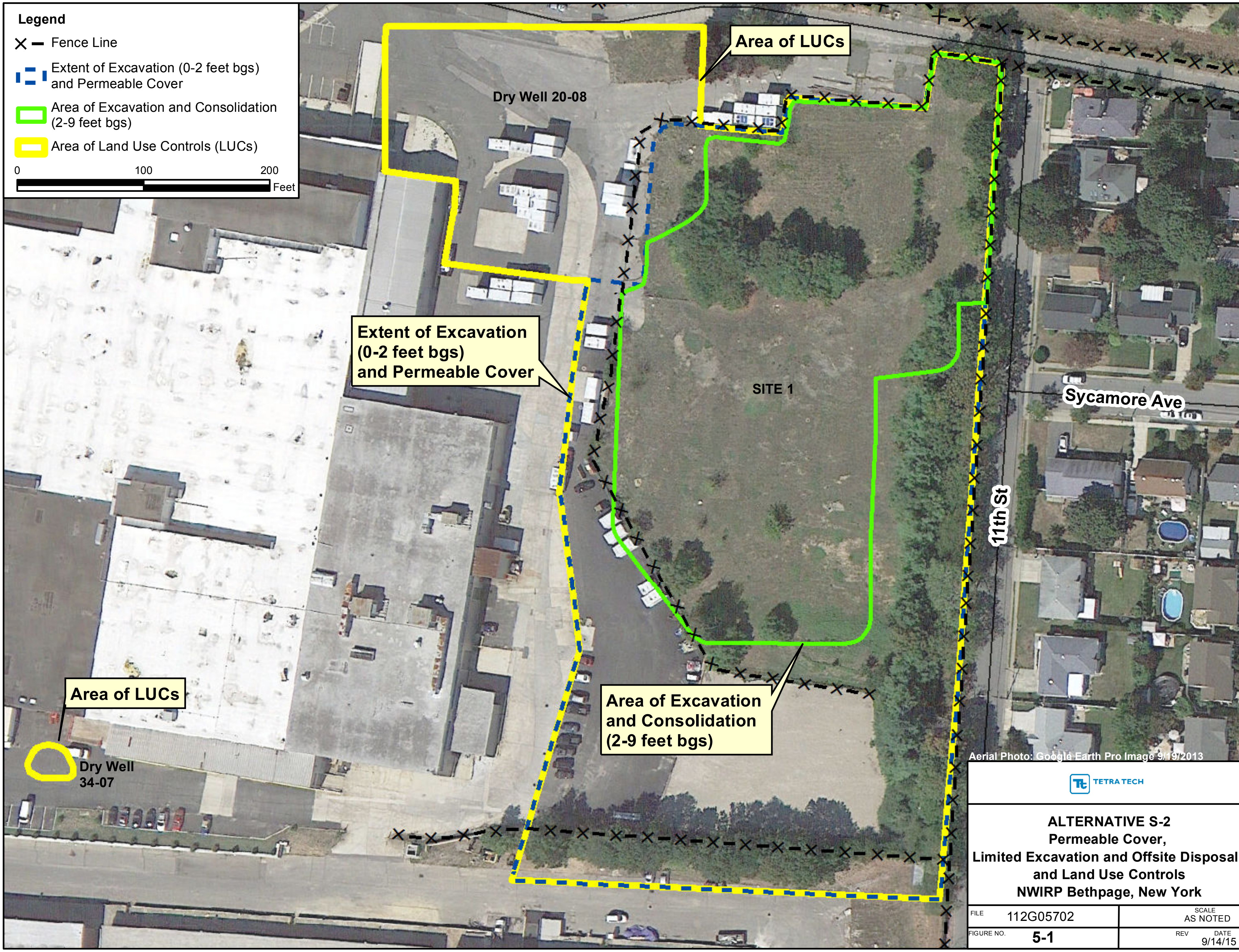
Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\GW_hex_intermediate.mxd

TETRA TECH

Intermediate Depth Groundwater
(95-200 Feet BGS)
Hexavalent Chromium
Contour Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage
Bethpage,New York

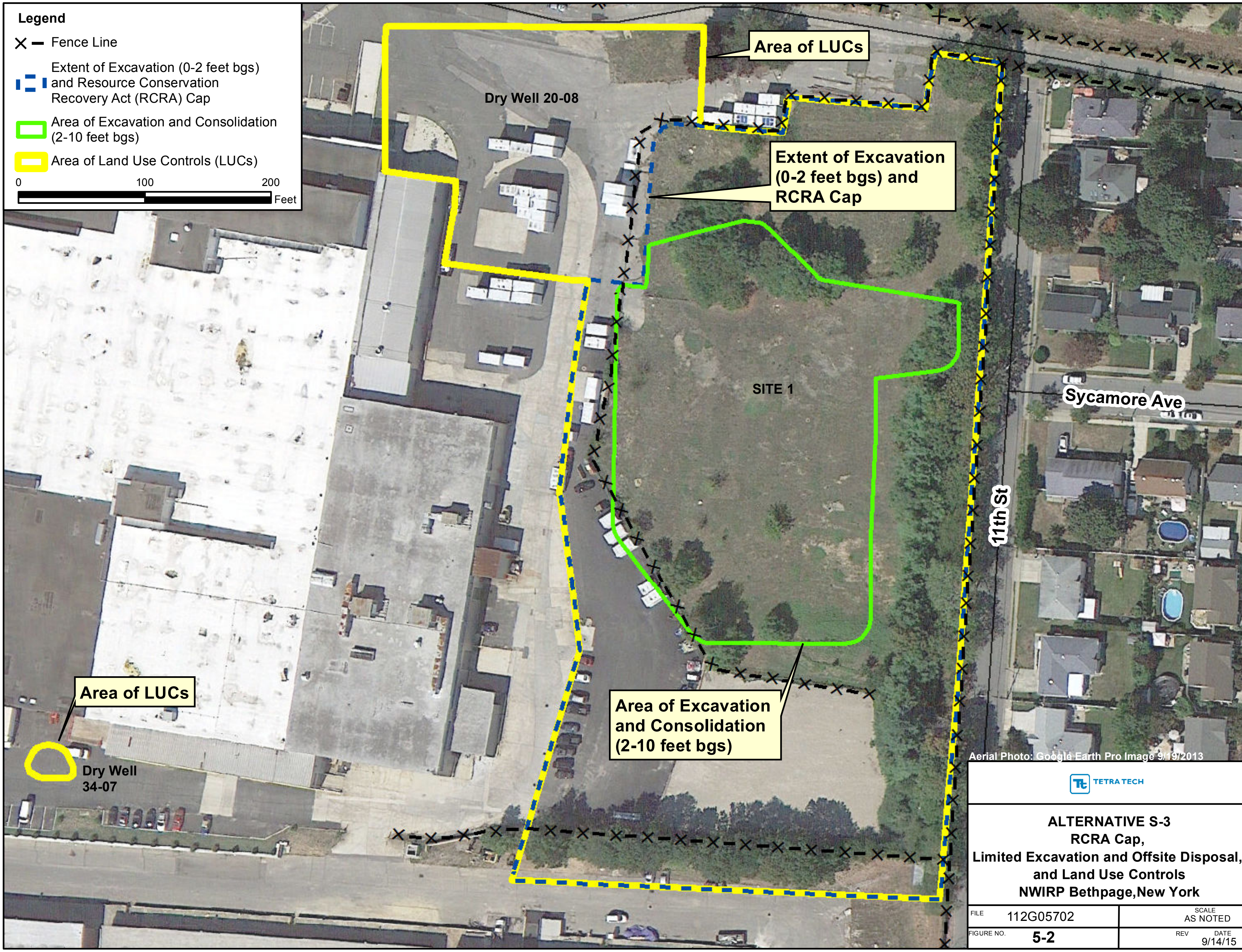
FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	2-17	REV	DATE 7/16/15

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\GW_hex_deep.mxd

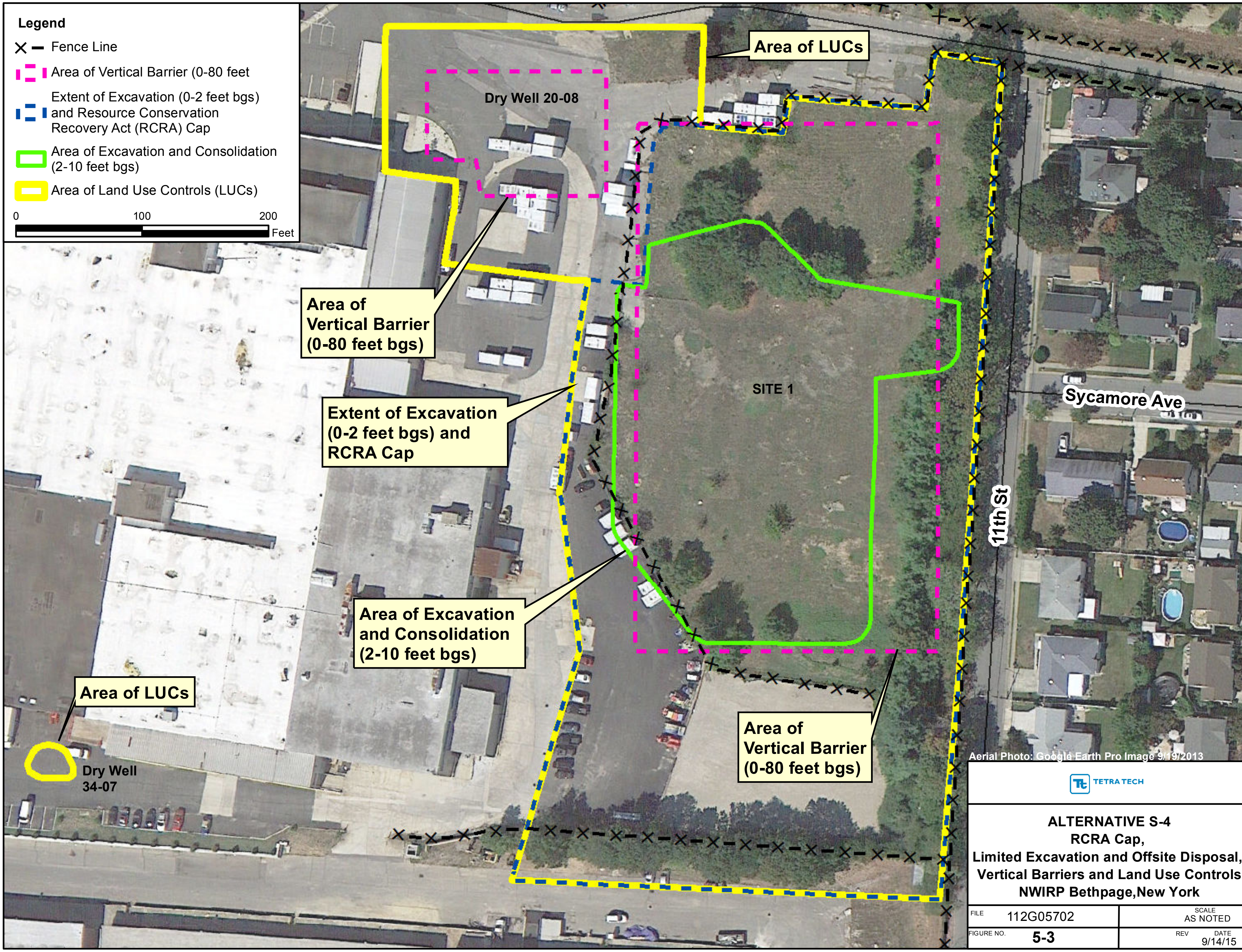


ALTERNATIVE S-2
Permeable Cover,
Limited Excavation and Offsite Disposal,
and Land Use Controls
NWIRP Bethpage, New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	**5-1**	REV	DATE 9/14/15



Legend
Fence Line
Extent of Excavation (0-2 feet bgs) and Resource Conservation Recovery Act (RCRA) Cap
Area of Excavation and Consolidation (2-10 feet bgs)
Area of Land Use Controls (LUCs)
0
100
200
Feet
Area of LUCs
Dry Well 20-08
Extent of Excavation (0-2 feet bgs) and RCRA Cap
SITE 1
Sycamore Ave
11th St
Area of LUCs
Dry Well 34-07
Area of Excavation and Consolidation (2-10 feet bgs)
Aerial Photo: Google Earth Pro Image 9/19/2013
TETRA TECH
ALTERNATIVE S-3
RCRA Cap,
Limited Excavation and Offsite Disposal,
and Land Use Controls
NWIRP Bethpage,New York
FILE 112G05702
SCALE AS NOTED
FIGURE NO. 5-2
REV
DATE 9/14/15


Legend
Fence Line
Area of Vertical Barrier (0-80 feet
Extent of Excavation (0-2 feet bgs) and Resource Conservation Recovery Act (RCRA) Cap
Area of Excavation and Consolidation (2-10 feet bgs)
Area of Land Use Controls (LUCs)
0
100
200
Feet
Area of LUCs
Dry Well 20-08
Area of Vertical Barrier (0-80 feet bgs)
Extent of Excavation (0-2 feet bgs) and RCRA Cap
SITE 1
Sycamore Ave
11th St
Area of Excavation and Consolidation (2-10 feet bgs)
Area of LUCs
Dry Well 34-07
Area of Vertical Barrier (0-80 feet bgs)
Aerial Photo: Google Earth Pro Image 9/19/2013
TETRA TECH
ALTERNATIVE S-4
RCRA Cap,
Limited Excavation and Offsite Disposal,
Vertical Barriers and Land Use Controls
NWIRP Bethpage,New York
FILE
112G05702
SCALE
AS NOTED
FIGURE NO.
5-3
REV
DATE
9/14/15
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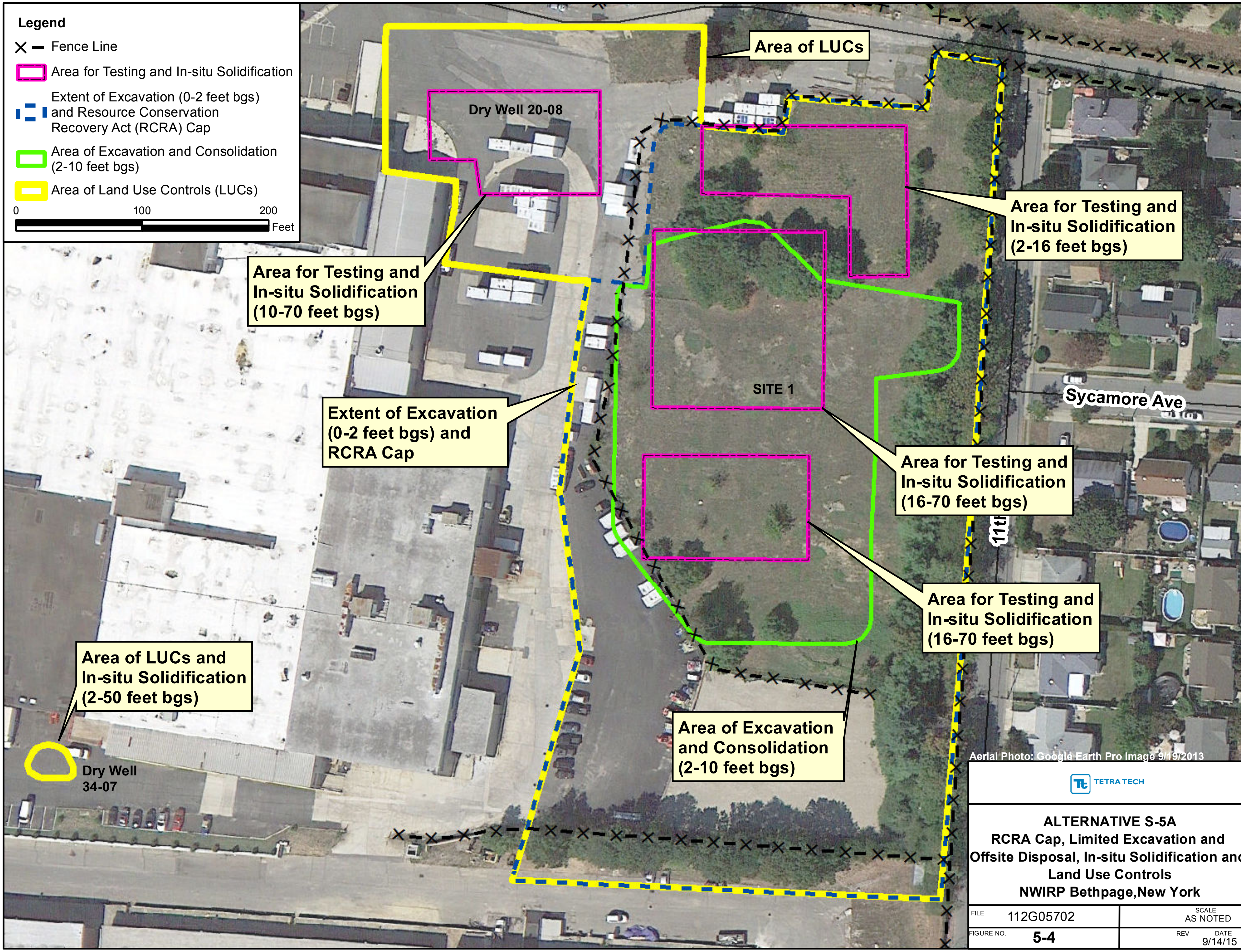
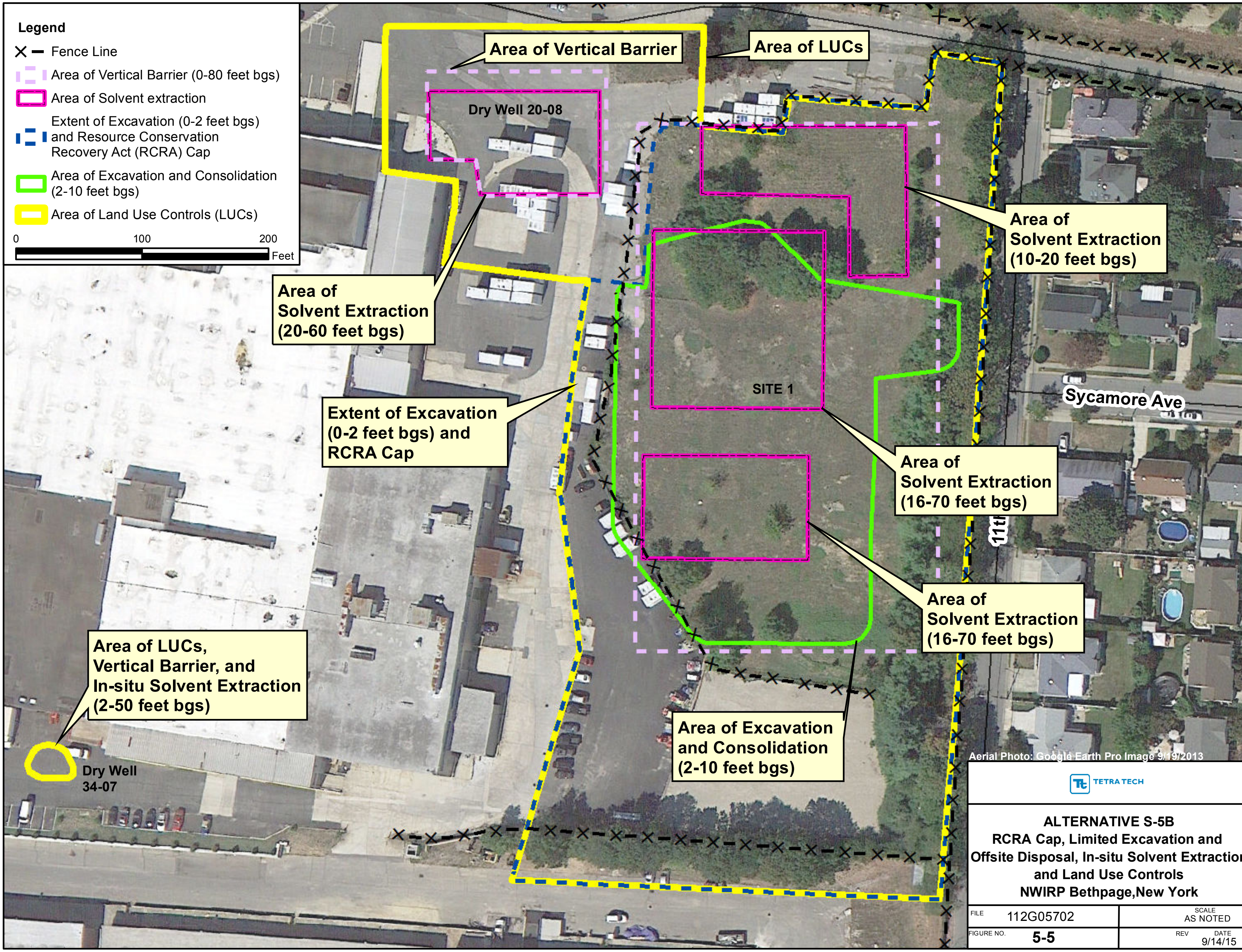
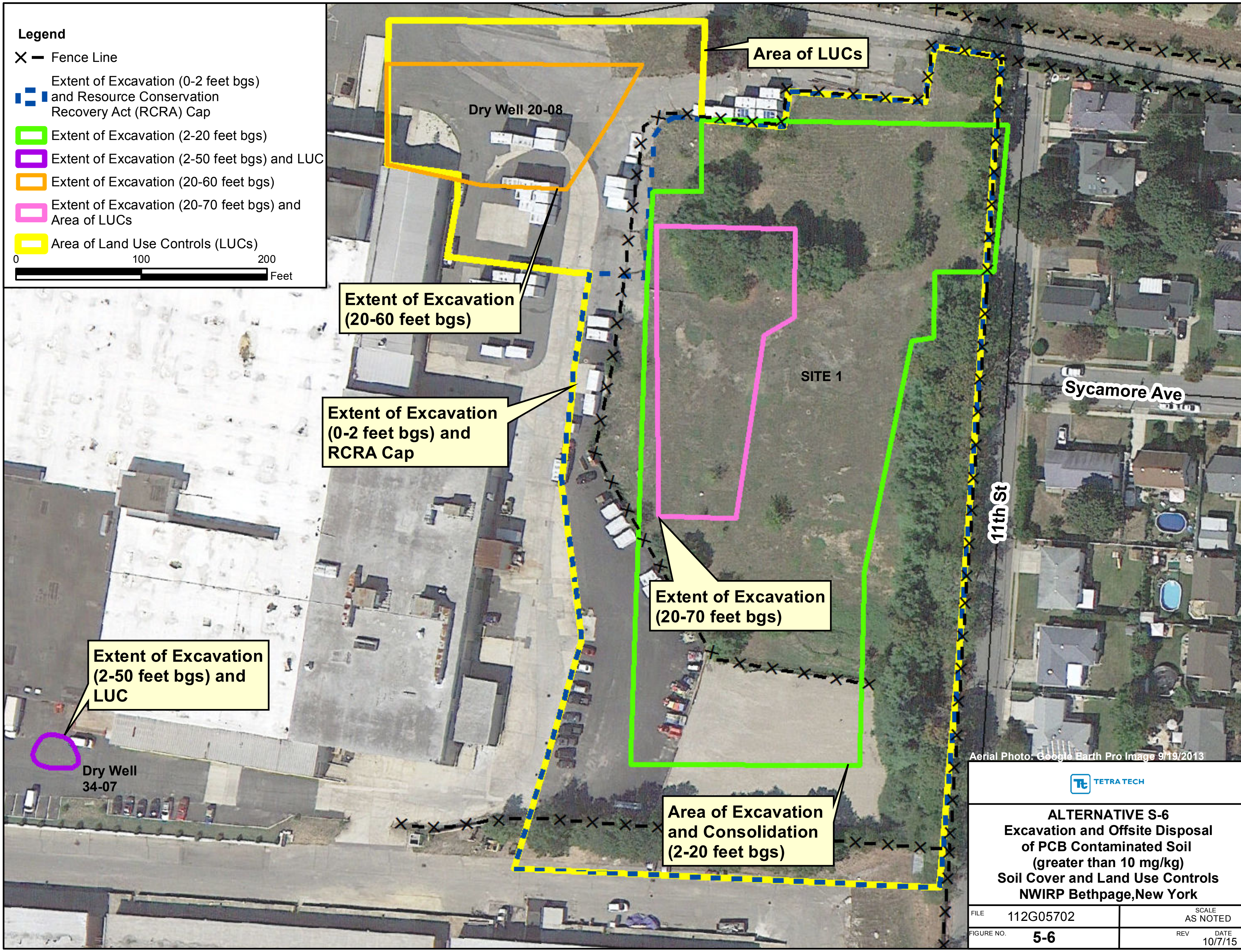


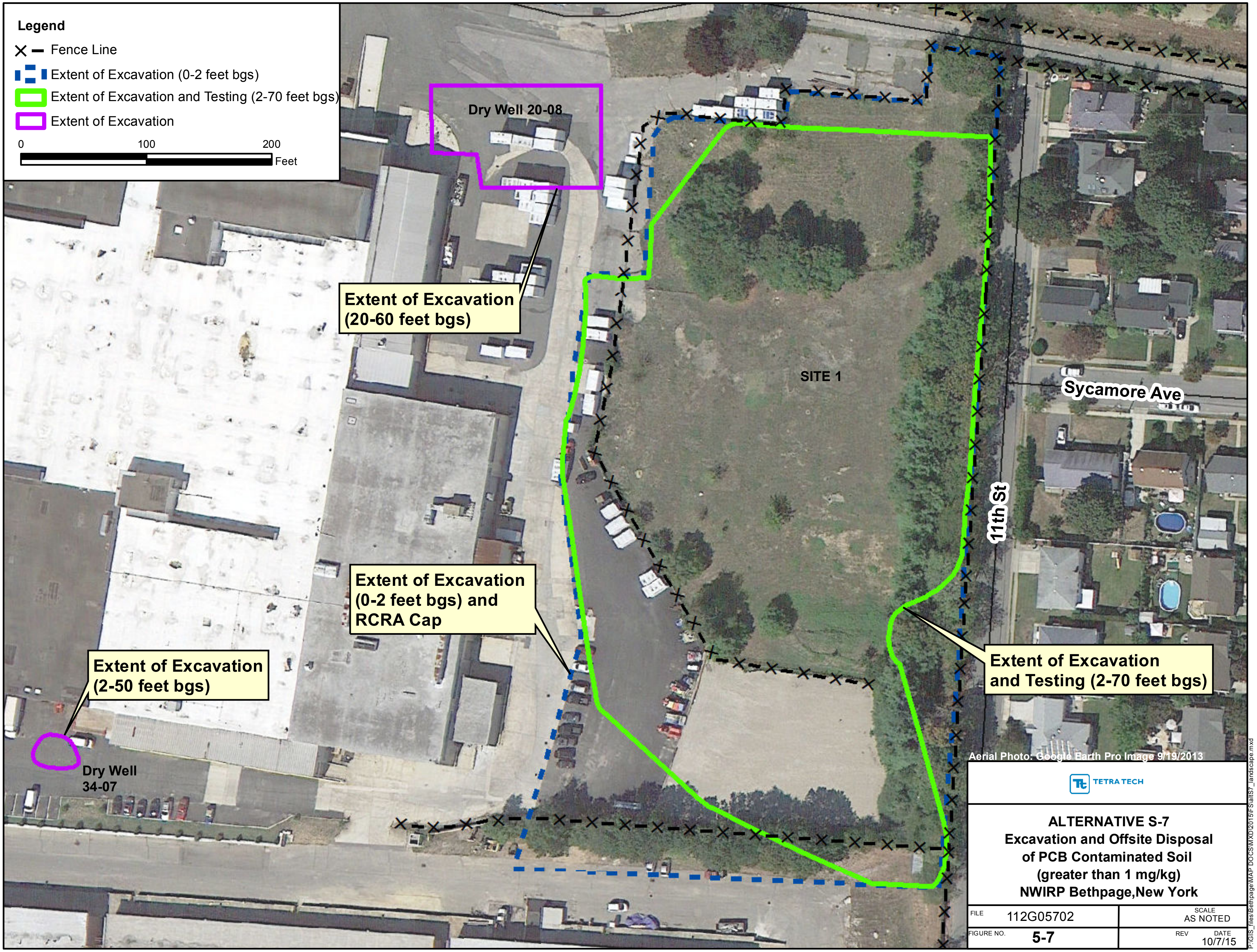
ALTERNATIVE S-5A
RCRA Cap, Limited Excavation and Offsite Disposal, In-situ Solidification and Land Use Controls
NWIRP Bethpage, New York

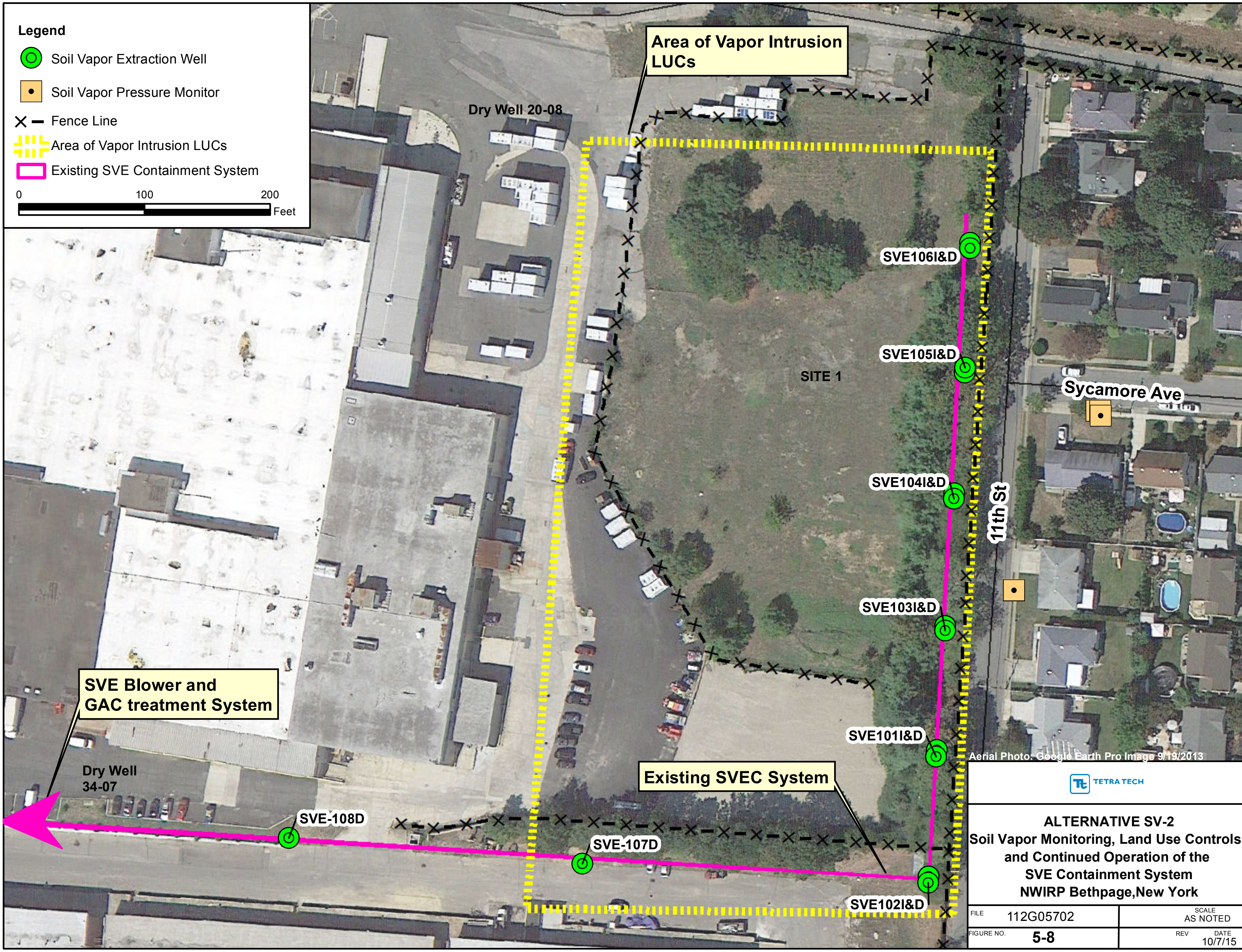
FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	5-4	REV	DATE 9/14/15


Legend
Fence Line
Area of Vertical Barrier (0-80 feet bgs)
Area of Solvent extraction
Extent of Excavation (0-2 feet bgs) and Resource Conservation Recovery Act (RCRA) Cap
Area of Excavation and Consolidation (2-10 feet bgs)
Area of Land Use Controls (LUCs)
0
100
200
Feet
Area of Vertical Barrier
Area of LUCs
Dry Well 20-08
Area of Solvent Extraction (10-20 feet bgs)
Area of Solvent Extraction (20-60 feet bgs)
SITE 1
Sycamore Ave
Extent of Excavation (0-2 feet bgs) and RCRA Cap
Area of Solvent Extraction (16-70 feet bgs)
Area of Solvent Extraction (16-70 feet bgs)
11th
Area of LUCs, Vertical Barrier, and In-situ Solvent Extraction (2-50 feet bgs)
Dry Well 34-07
Area of Excavation and Consolidation (2-10 feet bgs)
Aerial Photo: Google Earth Pro Image 9/19/2013
TETRA TECH
ALTERNATIVE S-5B
RCRA Cap, Limited Excavation and Offsite Disposal, In-situ Solvent Extraction and Land Use Controls
NWIRP Bethpage,New York
FILE
112G05702
SCALE
AS NOTED
FIGURE NO.
5-5
REV
DATE
9/14/15

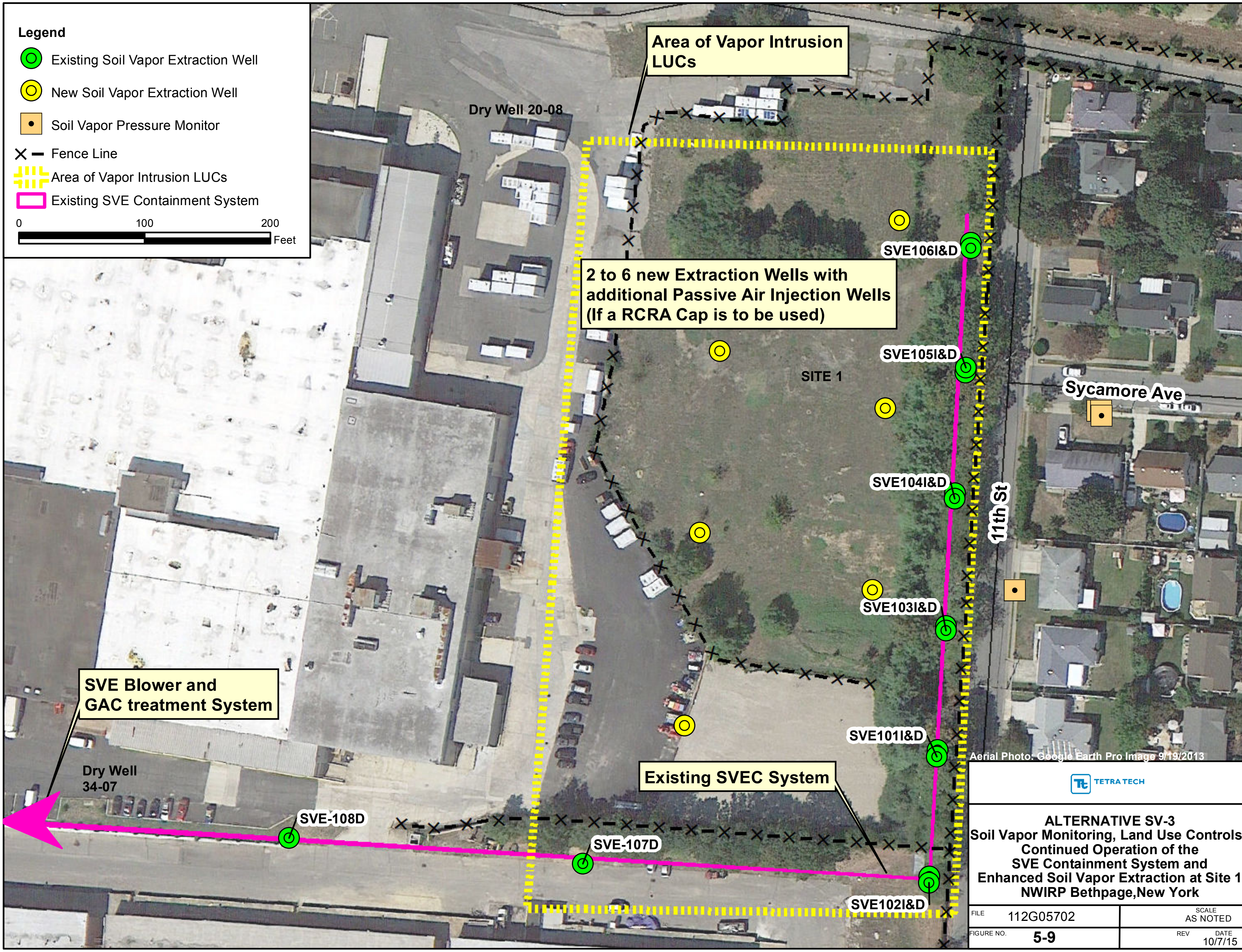


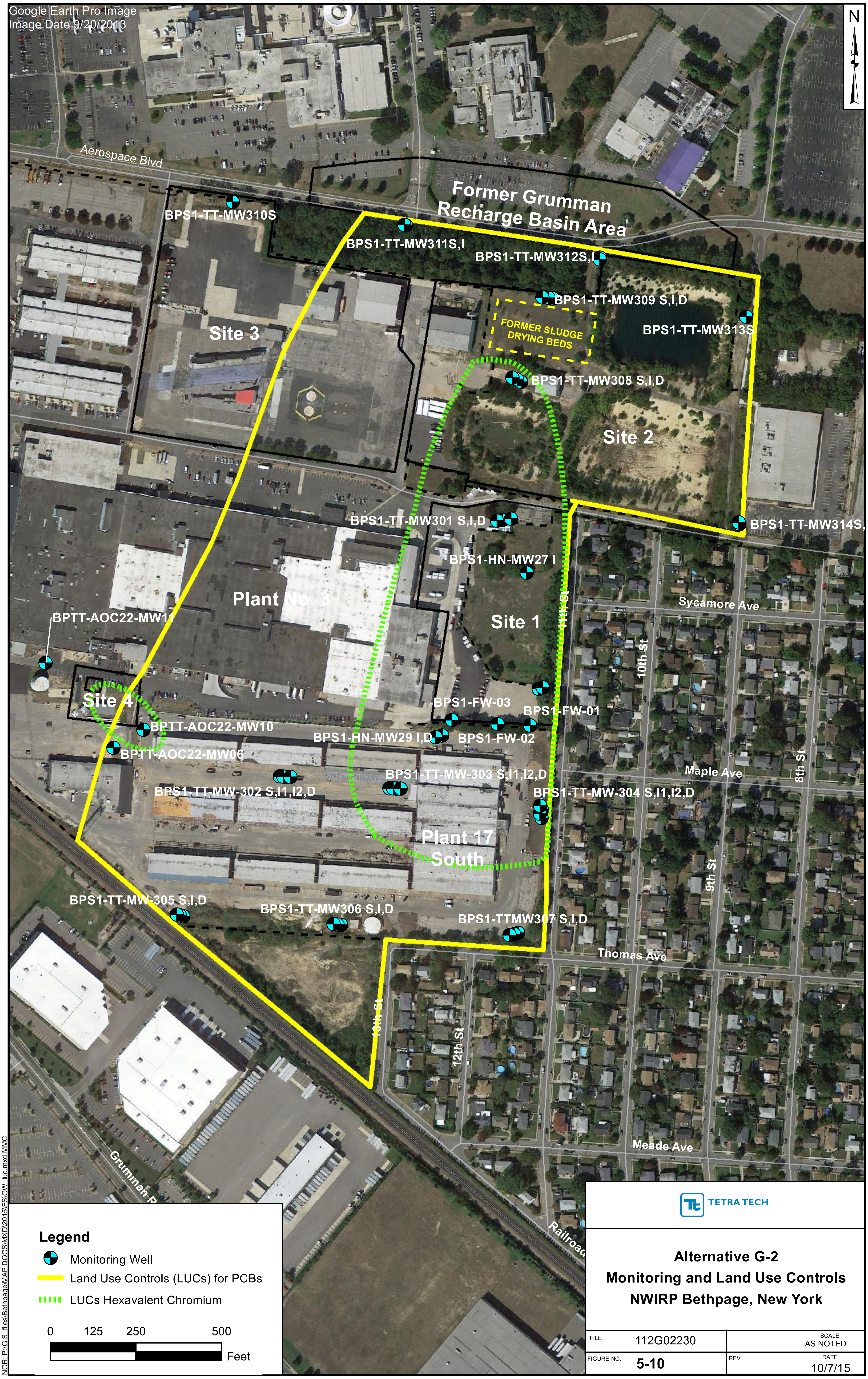
Legend
Fence Line
Extent of Excavation (0-2 feet bgs) and Resource Conservation Recovery Act (RCRA) Cap
Extent of Excavation (2-20 feet bgs)
Extent of Excavation (2-50 feet bgs) and LUC
Extent of Excavation (20-60 feet bgs)
Extent of Excavation (20-70 feet bgs) and Area of LUCs
Area of Land Use Controls (LUCs)
0
100
200
Feet
Area of LUCs
Dry Well 20-08
Extent of Excavation (20-60 feet bgs)
Extent of Excavation (0-2 feet bgs) and RCRA Cap
SITE 1
Sycamore Ave
11th St
Extent of Excavation (20-70 feet bgs)
Extent of Excavation (2-50 feet bgs) and LUC
Dry Well 34-07
Area of Excavation and Consolidation (2-20 feet bgs)
Aerial Photo: Google Earth Pro Image 9/19/2013
TETRA TECH
ALTERNATIVE S-6
Excavation and Offsite Disposal of PCB Contaminated Soil (greater than 10 mg/kg) Soil Cover and Land Use Controls
NWIRP Bethpage,New York
FILE 112G05702
SCALE AS NOTED
FIGURE NO. 5-6
REV
DATE 10/7/15


Legend
Fence Line
Extent of Excavation (0-2 feet bgs)
Extent of Excavation and Testing (2-70 feet bgs)
Extent of Excavation
0
100
200
Feet
Dry Well 20-08
Extent of Excavation (20-60 feet bgs)
SITE 1
Sycamore Ave
11th St
Extent of Excavation (0-2 feet bgs) and RCRA Cap
Extent of Excavation (2-50 feet bgs)
Dry Well 34-07
Extent of Excavation and Testing (2-70 feet bgs)
Aerial Photo: Google Earth Pro Image 9/19/2013
TETRA TECH
ALTERNATIVE S-7
Excavation and Offsite Disposal
of PCB Contaminated Soil
(greater than 1 mg/kg)
NWIRP Bethpage,New York
FILE
112G05702
SCALE
AS NOTED
FIGURE NO.
5-7
REV
DATE
10/7/15

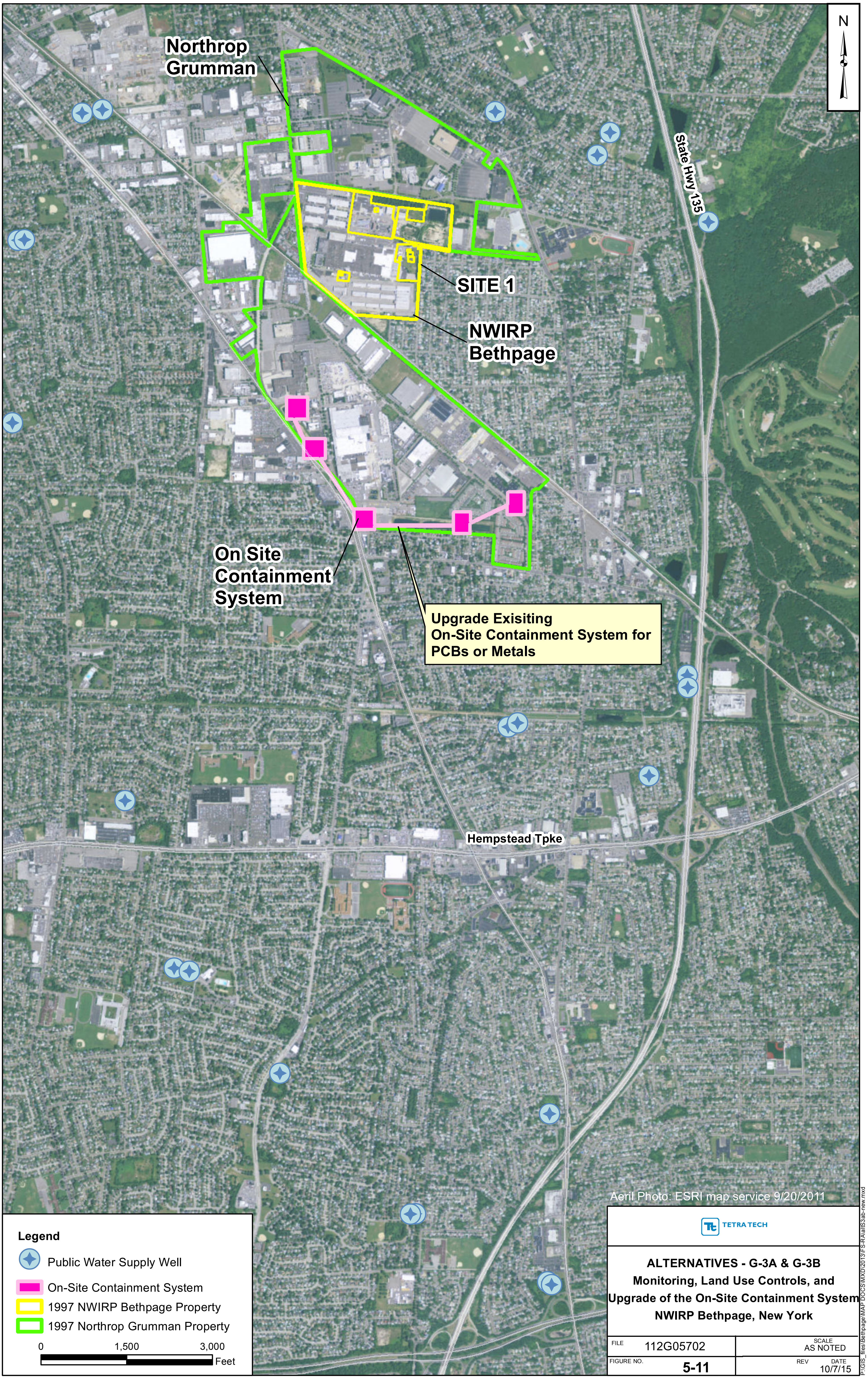


Legend
Soil Vapor Extraction Well
Soil Vapor Pressure Monitor
Fence Line
Area of Vapor Intrusion LUCs
Existing SVE Containment System
0
100
200
Feet
Area of Vapor Intrusion LUCs
Dry Well 20-08
SVE106I&D
SVE105I&D
SITE 1
Sycamore Ave
SVE104I&D
11th St
SVE103I&D
SVE Blower and GAC treatment System
SVE101I&D
Aerial Photo: Google Earth Pro Image 9/19/2013
Dry Well 34-07
Existing SVEC System
SVE-108D
SVE-107D
SVE102I&D
TETRA TECH
ALTERNATIVE SV-2
Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System
NWIRP Bethpage, New York
FILE 112G05702
SCALE AS NOTED
FIGURE NO. 5-8
REV
DATE 10/7/15


Legend
Existing Soil Vapor Extraction Well
New Soil Vapor Extraction Well
Soil Vapor Pressure Monitor
Fence Line
Area of Vapor Intrusion LUCs
Existing SVE Containment System
0
100
200
Feet
Area of Vapor Intrusion LUCs
Dry Well 20-08
2 to 6 new Extraction Wells with additional Passive Air Injection Wells (If a RCRA Cap is to be used)
SVE106I&D
SVE105I&D
SITE 1
Sycamore Ave
SVE104I&D
11th St
SVE103I&D
SVE101I&D
SVE Blower and GAC treatment System
Dry Well 34-07
Existing SVEC System
SVE-108D
SVE-107D
SVE102I&D
Aerial Photo: Google Earth Pro Image 9/19/2013
TETRA TECH
ALTERNATIVE SV-3
Soil Vapor Monitoring, Land Use Controls,
Continued Operation of the
SVE Containment System and
Enhanced Soil Vapor Extraction at Site 1
NWIRP Bethpage,New York
FILE
112G05702
SCALE
AS NOTED
FIGURE NO.
5-9
REV
DATE
10/7/15



Google Earth Pro Image
Image Date 9/20/2013
N
Aerospace Blvd
Former Grumman Recharge Basin Area
BPS1-TT-MW310S
BPS1-TT-MW311S,I
BPS1-TT-MW312S,I
BPS1-TT-MW309 S,I,D
BPS1-TT-MW313S
FORMER SLUDGE DRYING BEDS
BPS1-TT-MW308 S,I,D
Site 3
Site 2
BPS1-TT-MW301 S,I,D
BPS1-TT-MW314S,
BPS1-HN-MW27 I
Plant No. 3
Site 1
11th St
Sycamore Ave
10th St
BPTT-AOC22-MW11
Site 4
BPS1-FW-03
BPS1-FW-01
BPTT-AOC22-MW10
BPS1-HN-MW29 I,D
BPS1-FW-02
BPTT-AOC22-MW06
Maple Ave
8th St
BPS1-TT-MW-303 S,I1,I2,D
BPS1-TT-MW-302 S,I1,I2,D
BPS1-TT-MW-304 S,I1,I2,D
Plant 17 South
9th St
BPS1-TT-MW-305 S,I,D
BPS1-TT-MW306 S,I,D
BPS1-TTMW307 S,I,D
Thomas Ave
13th St
12th St
Meade Ave
Grumman R
Railroad
NOR P:\GIS_files\Bethpage\MAP DOCS\MXD\2015\FS\GW_luc.mxd MMC
Legend
Monitoring Well
Land Use Controls (LUCs) for PCBs
LUCs Hexavalent Chromium
0 125 250 500
Feet
TETRA TECH
Alternative G-2
Monitoring and Land Use Controls
NWIRP Bethpage, New York
FILE
112G02230
SCALE
AS NOTED
FIGURE NO.
5-10
REV
DATE
10/7/15



TETRA TECH

ALTERNATIVES - G-3A & G-3B
Monitoring, Land Use Controls, and Upgrade of the On-Site Containment System
NWIRP Bethpage, New York

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	5-11	REV	DATE 10/7/15

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APPENDIX A

MASS AND VOLUME CALCULATIONS

Tetra Tech, Inc.		*STANDARD CALCULATION SHEET*	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.1 PURPOSE:

To calculate the volume of contaminated soil and groundwater and the mass of polychlorinated biphenyls (PCBs) and metals present in contaminated media. Note that the mass of PCBs or metals in groundwater is representative of soluble mass in the aquifer, and does not include mass adsorbed to soil particles in the aquifer. The soil at Site 1 typically contains sandy loam with alternating bands of sand and gravelly sand. Soils are highly porous.

A.2 APPROACH:

Use isoconcentration contour mapping (verified by MVS software) to determine the areas of PCB contamination above 1, 10, 25, and 50 milligrams per kilogram (mg/kg) for soil (depending on soil depth interval and relevant criteria), or 0.5, 50 or 100 micrograms per liter (µg/L) for groundwater to determine the volume of contaminated media. Extended boundaries (blue boundaries) were used to determine the areas, to be conservative of existing data, as well as using inividual isocontours. These boundaries were drawn in GIS, and GIS software was used to calculate the areas, as presented on Figures A-1 through A-8 for soil contamination. Using the mean concentration, also calculate the mass of PCBs in soils and/or groundwater and hexavalent chromium in groundwater.

A.3 ASSUMPTIONS AND/OR CONSTANT VALUES:

1 yd^3	=	27	ft^3
density soil	=	112	lb soil/ft^3
1 ft^3	=	7.4805	gallons
1 gram	=	1000	mg
1 Kilogram	=	1000000	mg
1 gallon	=	3.785	Liters
1 pound	=	454	grams
1 acre	=	43,560	ft^2

A. 4 CALCULATE THE VOLUME OF CONTAMINATED SOIL AT <u>SITE 1</u> (ATTAINMENT AREA):

A.4.1 Calculate the volume of soil 0 - 2 feet below ground surface:

*See Appendix Figure A-1 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 1 mg/kg.

PCB Attainment Area > 1 mg/kg	Areal Extent (From Figure A-1) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
A-1	188,370	4.32	2	376,740	13,953
A-2	6,207	0.14	2	12,414	460
			TOTAL:	389,154	14,413

Example Calculation:

Volume (ft^3) = 188,370 ft^2 X 2 feet thick = 376,740 ft^3 = $\frac{376{,}740 \text{ ft}^3}{27 \text{ ft}^3/\text{yd}^3}$ = 13,953 cy

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.4.2 Calculate the volume of soil 2 - 9 feet below ground surface (10 mg/kg):
*See Appendix Figure A-2 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Attainment Area > 10 mg/kg	Area of Attainment Area (From Figure A-2) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
B-1	65,695	1.51	7	459,865	17,032
			TOTAL:	459,865	17,032

Example Calculation:

Volume (ft^3) = 65,695 ft^2 X 8 feet thick = 459,865 ft^3 = 17,032 CY

27 ft^3/yd^3

A.4.3 Calculate the volume of soil 2 - 10 feet below ground surface (25, 50 mg/kg):
*See Appendix Figure A-2 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Attainment Area > 25 mg/kg	Area of Attainment Area (From Figure A-2) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
B-1A	46,854	1.08	8	374,832	13,883
			TOTAL:	374,832	13,883

A.4.4 Calculate the volume of soil 9 - 20 feet below ground surface (10 mg/kg):
*See Appendix Figure A-3 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Attainment Area > 10 mg/kg	Area of Attainment Area (From Figure A-3) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
C-1	11,703	0.27	11	128,733	4,768
C-2	37,010	0.85	11	407,110	15,078
C-3	12,015	0.28	11	132,165	4,895
			TOTAL:	668,008	24,741

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.4.5 Calculate the volume of soil 10 - 20 feet below ground surface (25 mg/kg):

*See Appendix Figure A-3 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Attainment Area > 25 mg/kg	Area of Attainment Area (From Figure A-3) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
C-1	11,703	0.27	10	117,030	4,334
C-2	37,010	0.85	10	370,100	13,707
C-3A	2,214	0.05	10	22,140	820
	50,927		TOTAL:	509,270	18,861

Example Calculation:

Volume (ft^3) = 11,703 ft^2 X 10 feet thick = 117,030 ft^3 = 4,334 cy

$$\frac{117{,}030\ ft^3}{27\ ft^3/yd^3} = 4{,}334\ cy$$

A.4.6 Calculate the volume of soil 10 - 20 feet below ground surface (> 50 mg/kg):

*See Appendix Figure A-3 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Attainment Area > 50 mg/kg	Area of Attainment Area (From Figure A-3) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
C-1	11,703	0.27	10	117,030	4,334
C-2	37,010	0.85	10	370,100	13,707
			10	487,130	18,042

A.4.7 Calculate the volume of soil 20 - 30 feet below ground surface (>10 mg/kg):

*See Appendix Figure A-4 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg at Site 1.

PCB Attainment Area > 10 mg/kg	Area of Attainment Area (From Figure A-4) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
D-2	19,241	0.44	10	192,410	7,126
			TOTAL:	192,410	7,126

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.4.8 Calculate the volume of soil 20 - 30 feet below ground surface (>25 and >50 mg/kg):
*See Appendix Figure A-4 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over over 25 mg/kg at Site 1. **Note that the contours for the 25 mg/kg and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for both.**

PCB Attainment Area > 25 mg/kg & >50 mg/kg	Area of Attainment Area (From Figure A-4) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
D-2A	11,710	0.27	10	117,100	4,337
D-2B	3,329	0.08	10	33,290	1,233
			TOTAL:	150,390	5,570

Example Calculation:

Volume (ft^3) = 11,710 ft^2 X 10 feet thick = $\frac{117{,}100\ ft^3}{27\ ft^3/yd^3}$ = 4,337 cy

A.4.9 Calculate the volume of soil 30 - 40 feet below ground surface (>10, >25, >50 mg/kg):
*See Appendix Figure A-5 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg at Site 1. **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume and mass was assumed the same for each.**

PCB Attainment Area > 10 mg/kg & > 25 mg/kg & > 50 mg/kg	Area of Attainment Area (From Figure A-5) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
E-2	3,318	0.08	10	33,180	1,229
			TOTAL:	33,180	1,229

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.4.10 Calculate the volume of soil 40 - 50 feet below ground surface (>10, >25, and >50 mg/kg):
*See Appendix Figure A-6 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg at Site 1. **Note that the areas for the 10, 25, and 50 mg/kg contours are the same, and therefore the volume totals are assumed to be the same for each.**

PCB Attainment Area > 10 mg/kg & 25 mg/kg & 50 mg/kg	Area of Attainment Area (From Figure A-6) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
F-2	15,650	0.36	10	156,500	5,796
			TOTAL:	156,500	5,796

Example Calculation:

Volume (ft^3) = 15,650 ft^2 X 10 feet thick = 156,500 $\frac{ft^3 =}{27\ ft^3/yd^3}$ 5,796 cy

A.4.11 Calculate the volume of soil 50 - 60 feet below ground surface (>10, >25, and >50 mg/kg):
*See Appendix Figure A-7 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg at Site 1. **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for each.**

PCB Attainment Area > 10 mg/kg & > 25 mg/kg & > 50 mg/kg	Area of Attainment Area (From Figure A-7) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
G-2	15,650	0.36	10	156,500	5,796
G-3	3,340	0.08	10	33,400	1,237
			TOTAL:	189,900	7,033

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.4.12 Calculate the volume of soil 60 - 65 feet below ground surface (>10, >25, and >50 mg/kg):

*See Appendix Figure A-8 for area locations and calculated areas (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg at Site 1. **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for each.**

PCB Attainment Area > 10 mg/kg & > 25 mg/kg & > 50 mg/kgH	Area of Attainment Area (From Figure A-8) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
H-1	15,650	0.36	5	78,250	2,898
			TOTAL:	78,250	2,898

Example Calculation:

Volume (ft^3) = 15,650 ft^2 X 5 feet thick = 78,250 ft^3 = $\frac{}{27\ ft^3/yd^3}$ 2,898 cy

A.4.13 Calculate the total volume of potentially-contaminated soil at Site 1:

Volume of soil > 10 mg/kg =
Total = (Volume>1 mg/kg 0-2 ft bgs) + (Volume>10 mg/kg 2-9 ft bgs) + (Volume>10 mg/kg 9-20 ft bgs) + (Volume>10 mg/kg 20-30 ft bgs) + (Volume>10 mg/kg 30-40 ft bgs) + (Volume>10 mg/kg 40-50 ft bgs) + (Volume>10 mg/kg 50-60 ft bgs) + (Volume>10 mg/kg 60-65 ft bgs) = Volume (ft^3, cy)

= 2,167,267 ft^3 OR 80,269 cy

SAY 80,000 cy

Volume of soil > 25 mg/kg =
Total = (Volume>1 mg/kg 0-2 ft bgs) + (Volume>10 mg/kg 2-10 ft bgs) + (Volume>25 mg/kg 10-20 ft bgs) + (Volume>25 mg/kg 20-30 ft bgs) + (Volume>25 mg/kg 30-40 ft bgs) + (Volume>25 mg/kg 40-50 ft bgs) + (Volume>25 mg/kg 50-60 ft bgs) + (Volume>25 mg/kg 60-65 ft bgs) = Volume (ft^3, cy)

= 1,881,476 ft^3 OR 69,684 cy

SAY 70,000 cy

Volume of soil > 50 mg/kg =
Total = (Volume>1 mg/kg 0-2 ft bgs) + (Volume>50 mg/kg 2-10 ft bgs) + (Volume>50 mg/kg 10-20 ft bgs) + (Volume>50 mg/kg 20-30 ft bgs) + (Volume>50 mg/kg 30-40 ft bgs) + (Volume>50 mg/kg 40-50 ft bgs) + (Volume>50 mg/kg 50-60 ft bgs) + (Volume>50 mg/kg 60-65 ft bgs) = Volume (ft^3, cy)

1,859,336 ft^3 OR 68,864 cy

SAY 69,000 cy

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.5 CALCULATE THE TOTAL VOLUME AND MASS OF PCBs IN DRY WELL 34-07:

*See Appendix Figures A-9, A-10, A-11 for area boundaries. Criteria for this depth interval includes all soils over 10 ppm (10 mg/kg) and soils over 50 ppm (50 mg/kg).

Depth Interval (feet below ground surface) 10 mg/kg PCB contour	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration ł	Mass of PCBs [pounds (lbs)]
2-15	200	0.005	13	2,600	96	63	18
15-50	875	0.02	35	30,625	1,134	63	216
50-54	20	0.0005	4	79	3	63	0.6
			TOTAL:	33,304	1,233	TOTAL:	235

Say	1,200	CY (PCB >10 mg/kg)
	240	LBS (PCB > 10 mg/kg)

Example Calculation:

Mass PCBs (lbs) = $2{,}600\ ft^3 \times \dfrac{112 \text{ lb soil} \times 63 \text{ mg PCBs}}{ft^3 \quad 1 \times 10^{\wedge 6} \text{ mg soil}}$ 18 lbs PCBs

ł Note that the mean concentration was assumed to be the maximum concentration defining the PCB contour.

Depth Interval (feet below ground surface) 50 mg/kg PCB contour	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration ł	Mass of PCBs [pounds (lbs)]
2-15	75	0.002	13	975	36	158	17
15-50	198	0.005	35	6,940	257	158	123
			TOTAL:	7,915	293	TOTAL:	140

ł Note that the mean concentration was assumed to be the maximum concentration defining the PCB contour.

Say 300 CY (PCB >50 mg/kg)

For the 25 mg/kg contour, use the average of the 10 and 50 mg/kg

Volume		750	CY (PCB >25 mg/kg)
Mass		188	lbs (PCB >25 mg/kg)
	Say	190	lbs (PCB >25 mg/kg)

There is no contamination >50 mg/kg below 50 feet bgs.

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix A Mass and Volume Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 8/18/2015

A.6 CALCULATE THE VOLUME OF SOIL IN DW 20-08 (ATTAINMENT AREA):

No soil contamination remains at DW 20-08 in the interval of 0 to 20 feet bgs.

A.6.1 Calculate the volume of soil 20 - 30 feet below ground surface (>10, >25, and >50 mg/kg) at DW 20-08:

*See Appendix Figure A-4 for area locations and calculated areas (from GIS). **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for each.**

Use the average of the attainment and isoconcentration area.

PCB Attainment Area > 10, 25 and 50 mg/kg	Area of Attainment Area (From Figure A-4) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
D-1	8,671	0.20	10	86,710	3,211
			TOTAL:	86,710	3,211

Example Calculation:

Volume (ft^3) = 8,671 ft^2 X 10 feet thick = $\frac{86{,}710\ ft^3}{27\ ft^3/yd^3}$ = 3,211 cy

A.6.2 Calculate the volume of soil 30 - 40 feet below ground surface (>10, >25, and >50 mg/kg) at DW 20-08:

*See Appendix Figure A-5 for area locations and calculated areas (from GIS). **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for each.**

PCB Attainment Area > 10 mg/kg & > 25 mg/kg & > 50 mg/kg	Area of Attainment Area (From Figure A-5) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
E-1	8,671	0.20	10	86,710	3,211
			TOTAL:	86,710	3,211

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A.6.3 Calculate the volume of soil 40 - 50 feet below ground surface (>10, >25, and >50 mg/kg) at DW 20-08:

*See Appendix Figure A-6 for area locations and calculated areas (from GIS). **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for each.**

PCB Attainment Area > 10, 25, and 50 mg/kg	Area of Attainment Area (From Figure A-6) [square feet (ft^2)]	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
F-1	8,671	0.20	10	86,710	3,211
			TOTAL:	86,710	3,211

Example Calculation:

Volume (ft^3) = 8,671 ft^2 X 10 feet thick = $\frac{86{,}710 \ ft^3}{27 \ ft^3/yd^3}$ = 3,211 cy

A.6.4 Calculate the volume of soil 50 - 60 feet below ground surface at DW 20-08:

*See Appendix Figure A-7 for area locations and calculated areas (from GIS). **Note that the 10 mg/kg, 25 mg/kg, and 50 mg/kg contours are the same for this depth interval. The soil volume was assumed the same for each.**

PCB Attainment Area > 10 mg/kg & > 25 mg/kg & > 50 mg/kg	Area of Attainment Area (From Figure A-7) (ft^2)	Area of Attainment Area (acres)	Contaminant Thickness (feet)	Volume of Attainment Area (ft^3)	Volume of Attainment Area (cy)
G-1	8,671	0.20	10	86,710	3,211
			TOTAL:	86,710	3,211

No contamination exists beyond 60 feet bgs for DW 20-08.

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A.6.5 Calculate the total volume of potentially-contaminated soil at Dry Well 20-08:

Volume > 10 mg/kg =

Total = (Volume>10 mg/kg 20-30 ft bgs) + (Volume>10 mg/kg 30-40 ft bgs) + (Volume>10 mg/kg 40-50 ft bgs) + (Volume>10 mg/kg 50-60 ft bgs) = Volume (ft^3, cy)

= 346,840 ft^3 OR 12,846 cy

SAY 12,800 cy

Volume > 25 mg/kg =

Volume > 10 mg/kg (Note that the volume is the same as in the 10 mg/kg contour).

Volume > 50 mg/kg =

Volume > 10 mg/kg (Note that the volume is the same as in the 10 mg/kg contour).

A.7 Calculate the total volume of potentially-contaminated soil in Dry Wells 20-08, 34-07, and Site 1:

Volume > 10 mg/kg =

In a soil volume of= 94,000 cy

Volume > 25 mg/kg =

In a soil volume of= 83,550 cy

Say 84,000 cy

Volume > 50 mg/kg =

In a soil volume of= 82,100 cy

Say 82,000 cy

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A.8 CALCULATE THE MASS OF TOTAL PCBs IN CONTAMINATED SOILS AT SITE 1 (GREEN CONTOUR):

A.8.1 Calculate the mass of total PCBs in 0 - 2 feet below ground surface (>1 mg/kg) at Site 1:

*See Appendix Figure A-1 for area locations and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soil over 1 mg/kg.

PCB Contour Within Attainment Area > 1 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
A-1	151,952	3.49	2	303,904	11,256	12.36	421
A-2	195	0.004	2	390	14	1.3	0.06
			TOTAL:	304,294	11,270	TOTAL:	421

Example Calculation:

Mass PCBs (lbs) = 303,904 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{12.36 \text{ mg PCB}}{1 \text{ X } 10^{6} \text{ mg soil}}$ 421 lbs PCBs

A.8.2 Calculate the mass of total PCBs in 2 - 10 feet below ground surface (>10 mg/kg) at Site 1:

*See Appendix Figure A-2 for area locations and mean PCB concentrations (from GIS). Criteria for this depth interval includes soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs (lbs)
B-1	24,599	0.56	8	196,792	7,289	44.94	990.5
			TOTAL:	196,792	7,289	TOTAL:	991

A.8.3 Calculate the mass of total PCBs in 2 - 10 feet below ground surface (>25 mg/kg) at Site 1:

*See Appendix Figure A-2 for area locations and mean PCB concentrations (from GIS). Criteria for this depth interval includes soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs (lbs)
B-1A	9,328	0.21	8	74,624	2,764	91.78	767
			TOTAL:	74,624	2,764	TOTAL:	767

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A.8.4 Calculate mass of total PCBs in 10 - 20 feet below ground surface (>10 mg/kg) at Site 1:
*See Appendix Figure A-3 for area locations and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soil over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
C-1	1,171	0.03	10	11,710	434	12	16
C-3	2,435	0.06	10	24,350	902	17.3	47
C-2A	2,088	0.05	10	20,880	773	21.2	50
C-2B	4,837	0.11	10	48,370	1,791	207.6	1,125
C-2C	914	0.02	10	9,140	339	52	53
C-2D	124	0.00	10	1,240	46	16	2.2
C-2E	290.35	0.01	10	2,904	108	16	5.2
C-2F	1,798	0.04	10	17,980	666	360.1	725
C-3A	2,214	0.05	10	22,140	820	10.5	26
			TOTAL:	158,714	5,879	TOTAL:	2,049

Example Calculation:

Mass PCBs (lbs) = 11,710 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{12 \text{ mg PCBs}}{1 \text{ X } 10^{6} \text{ mg soil}}$ 16 lbs PCBs

A.8.5 Calculate the mass of total PCBs in 10 - 20 feet below ground surface (>25 mg/kg) at Site 1:
*See Appendix A-3 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soil over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs (lbs)
C-1	567	0.01	10	5,670	210	43	27
C-3	81	0.00	10	810	30	42.4	4
C-2A	1,186	0.03	10	11,860	439	469.2	623
C-2B	1,516	0.03	10	15,160	561	235	399
C-2C	596	0.01	10	5,960	221	83	55
C-2D	50.42	0.00	10	504	19	26	1
C-2E	140.66	0.00	10	1,407	52	26	4
C-2F	1,054	0.02	10	10,540	390	583.3	689
C-3A	81	0.00	10	810	30	42.4	4
			TOTAL:	52,721	1,952	TOTAL:	1,806

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A.8.6 Calculate the mass of total PCBs in 10 - 20 feet below ground surface (>50 mg/kg) at Site 1:
*See Appendix Figure A-3 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soil over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
C-1	195	0.00	10	1,950	72	61	13
C-2A	441	0.01	10	4,410	163	933.3	461
C-2B	864	0.02	10	8,640	320	413	400
C-2C	374	0.01	10	3,740	139	118	49
C-2F	441	0.01	10	4,410	163	933.3	461
			TOTAL:	23,150	857	TOTAL:	1,384

Example Calculation:

Mass PCBs (lbs) = 1,950 ft^3 X $\dfrac{112 \text{ lb soil X } 61 \text{ mg PCBs}}{ft^3 \quad 1 \text{ X } 10^{\wedge 6} \text{ mg soil}}$ 13 lbs PCBs

A.8.7 Calculate the mass of total PCBs in 20 - 30 feet below ground surface (>10 mg/kg) at Site 1:
*See Appendix Figure A-4 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soil over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs (lbs)
D-2	1,851	0.04	10	18,510	685.6	39	81
			TOTAL:	18,510	686	TOTAL:	81

A.8.8 Calculate the mass of total PCBs in 20 - 30 feet below ground surface (>25 mg/kg) at Site 1:
*See Appendix Figure A-4 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes soil over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
D-2A	624	0.01	10	6,240	231	62	43.3
D-2B	317	0.01	10	3,170	117	52	18.5
			TOTAL:	9,410	349	TOTAL:	62

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A.8.9 Calculate the mass of total PCBs in 20 - 30 feet below ground surface (>50 mg/kg) at Site 1:
*See Appendix Figure A-4 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes soil over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs [pounds (lbs)]
D-2A	321	0.01	10	3,210	118.9	87	31.3
D-2B	107	0.00	10	1,070	39.6	73	8.7
			TOTAL:	4,280	159	TOTAL:	40

Example Calculation:

Mass PCBs (lbs) = $3{,}210\ ft^3 \times \dfrac{112\ \text{lb soil}}{ft^3} \times \dfrac{87\ \text{mg PCBs}}{1 \times 10^{6}\ \text{mg soil}}$ 31.3 lbs PCBs

A.8.10 Calculate the mass of total PCBs in 30 - 40 feet below ground surface (>10 mg/kg) at Site 1:
*See Appendix Figure A-5 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
E-2	431	0.01	10	4,310	160	27	13
E-3	531	0.01	10	5,310	197	40	24
			TOTAL:	9,620	356	TOTAL:	37

A.8.11 Calculate the mass of total PCBs in 30 - 40 feet below ground surface (>25 mg/kg) at Site 1:
*See Appendix Figure A-5 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
E-2	180	0.00	10	1,800	67	42	8
E-3	178	0.00	10	1,780	66	63	13
			TOTAL:	3,580	133	TOTAL:	21

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PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
E-2	68	0.00	10	680	25	60	5
E-3	82	0.00	10	820	30	89	8
			TOTAL:	1,500	56	TOTAL:	13

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A.8.13 Calculate the mass of total PCBs in 40 - 50 feet below ground surface (>10 mg/kg) at Site 1:
*See Appendix Figure A-6 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs [pounds (lbs)]
F-2	431	0.01	10	4,310	160	27	13
			TOTAL:	4,310	160	TOTAL:	13

Example Calculation:

Mass PCBs (lbs) = 4,310 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{27 \text{ mg PCBs}}{1 \times 10^{6} \text{ mg soil}}$ 13 lbs PCBs

A.8.14 Calculate the mass of total PCBs in 40 - 50 feet below ground surface (>25 mg/kg) at Site 1:
*See Appendix Figure A-6 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
F-2	180	0.00	10	1,800	67	42	8
			TOTAL:	1,800	67	TOTAL:	8

A.8.15 Calculate the mass of total PCBs in 40 - 50 feet below ground surface (> 50 mg/kg) at Site 1:
*See Appendix Figure A-6 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
F-2	68	0.00	10	680	25	60	5
			TOTAL:	680	25	TOTAL:	5

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A.8.16 Calculate the mass of total PCBs in 50 - 60 feet below ground surface (>10 mg/kg) at Site 1:
*See Appendix Figure A-7 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
G-2	5,633	0.13	10	56,330	2,086.3	22	138.8
G-3	384	0.01	10	3,840	142.2	43.34	18.6
			TOTAL:	60,170	2,229	TOTAL:	157

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A.8.17 Calculate the mass of total PCBs in 50 - 60 feet below ground surface (>25 mg/kg) at Site 1:
*See Appendix Figure A-7 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs [pounds (lbs)]
G-2	4,210	0.10	10	42,100	1,559	35	165.0
G-3	211	0.00	10	2,110	78	65	15.4
			TOTAL:	44,210	1,637	TOTAL:	180

Example Calculation:

Mass PCBs (lbs) = 42,100 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{35 \text{ mg PCBs}}{1 \text{ X } 10^{6} \text{ mg soil}}$ 165 lbs PCBs

A.8.18 Calculate the mass of total PCBs in 50 - 60 feet below ground surface (>50 mg/kg) at Site 1:
*See Appendix Figure A-7 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
G-2	1,437	0.03	10	14,370	532.2	50	80.5
G-3	55	0.00	10	550	20.4	82	5.1
			TOTAL:	14,920	553	TOTAL:	86

A.8.19 Calculate the mass of total PCBs in 60 - 65 feet below ground surface (> 10 mg/kg) at Site 1:
*See Appendix Figure A-8 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
H-1	560	0.01	5	2,800	104	25	8
			TOTAL:	2,800	104	TOTAL:	8

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A.8.20 Calculate the mass of total PCBs in 60 - 65 feet below ground surface (>25 mg/kg) at Site 1:
*See Appendix Figure A-8 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
H-1	315	0.01	5	1,575	58	39	7
			TOTAL:	1,575	58	TOTAL:	7

Example Calculation:

Mass PCBs (lbs) = 1,575 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{39 \text{ mg PCBs}}{1 \text{ X } 10^{6} \text{ mg soil}}$ 7 lbs PCBs

A.8.21 Calculate the mass of total PCBs in 60 - 65 feet below ground surface (>50 mg/kg) at Site 1:
*See Appendix Figure A-8 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
H-2	140	0.00	5	700	26	56	4
			TOTAL:	700	26	TOTAL:	4

A.8.22 Calculate the total mass of PCBs at Site 1 (isocontours):

Mass PCBs > 1 mg/kg 0 - 2 feet bgs and > 10 mg/kg 2 - 65 feet bgs =

Total = (Mass PCBs>1 mg/kg 0-2 ft bgs) + (Mass PCBs>10 mg/kg 2-10 ft bgs) + (Mass PCBs>10 mg/kg 10-20 ft bgs) + (Mass PCBs>10 mg/kg 20-30 ft bgs) + (Mass PCBs>10 mg/kg 30-40 ft bgs) + (Mass PCBs>10 mg/kg 40-50 ft bgs) + (Mass PCBs>10 mg/kg 50-60 ft bgs) + (Mass PCBs>10 mg/kg 60-65 ft bgs) = Mass PCBs (lbs)

Mass PCBs >1 and 10 mg/k 3,756 lbs SAY 3,800 lbs

22,336 CY 56 mg/kg

Mass PCBs > 1 mg/kg 0 - 2 feet bgs and >25 mg/kg 2 - 65 feet bgs =

Total = (Mass PCBs>1 mg/kg 0-2 ft bgs) + (Mass PCBs>10 mg/kg 2-10 ft bgs) + (Mass PCBs>25 mg/kg 10-20 ft bgs) + (Mass PCBs>25 mg/kg 20-30 ft bgs) + (Mass PCBs>25 mg/kg 30-40 ft bgs) + (Mass PCBs>25 mg/kg 40-50 ft bgs) + (Mass PCBs>25 mg/kg 50-60 ft bgs) + (Mass PCBs>25 mg/kg 60-65 ft bgs) = Mass PCBs (lbs)

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Mass PCBs > 25 mg/kg =	3,272 lbs	SAY	3,300 lbs
10,340 CY	105 mg/kg		

Mass PCBs > 1 mg/kg 0 - 2 feet bgs and > 50 mg/kg 10 - 65 feet bgs =

Total = (Mass PCBs>1 mg/kg 0-2 ft bgs) + (Mass PCBs>25 mg/kg 2-10 ft bgs) + (Mass PCBs>50 mg/kg 10-20 ft bgs) + (Mass PCBs>50 mg/kg 20-30 ft bgs) + (Mass PCBs>50 mg/kg 30-40 ft bgs) + (Mass PCBs>50 mg/kg 40-50 ft bgs) + (Mass PCBs>50 mg/kg 50-60 ft bgs) + (Mass PCBs>50 mg/kg 60-65 ft bgs) = Mass PCBs (lbs)

Mass PCBs > 50 mg/kg =	2,719 lbs	SAY	2,800 lbs
7,820 CY	116 mg/kg		

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A.9 CALCULATE THE MASS OF TOTAL PCBs in DW 20-08 (GREEN CONTOUR):
No soil contamination remains at DW 20-08 in the interval of 0 to 20 feet bgs.

A.9.1 Calculate the mass of total PCBs in 20 - 30 feet below ground surface at DW 20-08 (>10 mg/kg):
*See Appendix Figure A-4 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
D-1	5,956	0.14	10	59,560	2,206	300	2,001
			TOTAL:	59,560	2,206	TOTAL:	2,001

Example Calculation:

Mass PCBs (lbs) = 59,560 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{300 \text{ mg PCBs}}{1 \text{ X } 10^6 \text{ mg soil}}$ 2,001 lbs PCBs

A.9.2 Calculate the mass of total PCBs in 20 - 30 feet below ground surface (>25 mg/kg) at DW 20-08:
*See Appendix Figure A-4 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs (lbs)
D-1	3,384	0.08	10	33,840	1,253	474	1,796
			TOTAL:	33,840	1,253	TOTAL:	1,796

A.9.3 Calculate the mass of total PCBs in 20 - 30 feet below ground surface (>50 mg/kg) at DW 20-08:
*See Appendix Figure A-4 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs (lbs)
D-1	1,688	0.04	10	16,880	625	671	1,269
			TOTAL:	16,880	625	TOTAL:	1,269

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A.9.4 Calculate the mass of total PCBs in 30 - 40 feet below ground surface (> 10 mg/kg) at DW 20-08:
*See Appendix Figure A-5 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
E-1	4,260	0.10	10	42,600	1,578	69	329
			TOTAL:	42,600	1,578	TOTAL:	329

Example Calculation:

Mass PCBs (lbs) = 42,600 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{69 \text{ mg PCBs}}{1 \text{ X } 10^6 \text{ mg soil}}$ 329 lbs PCBs

A.9.5 Calculate the mass of total PCBs in 30 - 40 feet below ground surface (> 25 mg/kg) at DW 20-08:
*See Appendix Figure A-5 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
E-1	2,103	0.05	10	21,030	779	110	259
			TOTAL:	21,030	779	TOTAL:	259

A.9.6 Calculate the mass of total PCBs in 30 - 40 feet below ground surface (>50 mg/kg) at DW 20-08:
*See Appendix Figure A-5 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
E-1	1,377	0.03	10	13,770	510	155	239
			TOTAL:	13,770	510	TOTAL:	239

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A.9.7 Calculate the mass of total PCBs in 40 - 50 feet below ground surface (>10 mg/kg) at DW 20-08:
*See Appendix Figure A-6 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs [pounds (lbs)]
F-1	1,006	0.02	10	10,060	373	38	43
			TOTAL:	10,060	373	TOTAL:	43

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A.9.8 Calculate the mass of total PCBs in 40 - 50 feet below ground surface (>25 mg/kg) at DW 20-08:

*See Appendix Figure A-6 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
F-1	656	0.02	10	6,560	243	60	44
			TOTAL:	6,560	243	TOTAL:	44

Example Calculation:

Mass PCBs (lbs) = 6,560 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{60 \text{ mg PCBs}}{1 \text{ X } 10^{6} \text{ mg soil}}$ 44 lbs PCBs

A.9.9 Calculate the mass of total PCBs in 40 - 50 feet below ground surface (> 50 mg/kg) at DW 20-08:

*See Appendix Figure A-6 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 50 mg/kg.

PCB Contour Within Attainment Area > 50 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
F-1	35	0.00	10	350	13	85	3
			TOTAL:	350	13	TOTAL:	3

A.9.10 Calculate the mass of total PCBs in 50 - 60 feet below ground surface (>10 mg/kg) at DW 20-08:

*See Appendix Figure A-7 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 10 mg/kg.

PCB Contour Within Attainment Area > 10 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
G-1	912	0.02	10	9,120	338	51	52
			TOTAL:	9,120	338	TOTAL:	52

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A.9.11 Calculate the mass of total PCBs in 50 - 60 feet below ground surface (> 25 mg/kg) at DW 20-08:
*See Appendix Figure A-7 for area locations, calculated areas and mean PCB concentrations (from GIS). Criteria for this depth interval includes all soils over 25 mg/kg.

PCB Contour Within Attainment Area > 25 mg/kg	Area of Contour (ft^2)	Area of Contour (acres)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour	Mass of PCBs (lbs)
G-1	521	0.01	10	5,210	193	81	47
			TOTAL:	5,210	193	TOTAL:	47

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A.11 CALCULATE THE VOLUME AND MASS OF TOTAL PCBs IN CONTAMINATED GROUNDWATER:

A.11.1 Calculate the volume and mass of total PCBs in shallow groundwater (40 - 67 feet below ground surface)

*See Appendix Figure A-12 for area locations and calculated areas. The mean concentration used to calculate the mass of PCBs present in the aquifer was the outer boundary [i.e. 0.09 micrograms per liter (µg/L), 0.5 µg/L, or 1.0 µg/L]

0.09 µg/L - 0.5 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)	Mass of PCBs (pounds)
1,355,434	31	40 - 67	27	36,596,718	68,435,863	0.09	0.05

ƚ A porosity of 0.25 was used.

Example Calculation: Volume of contaminated groundwater = Volume (ft^3) X 7.48 gallons/ft^3 X 0.25

Volume = 36,596,718 ft^3 X 7.48 X 0.25 = 68,435,863 gallons

Example Calculation:

Mass of PCBs (lbs) = $\frac{0.09\ \mu g}{L} \times \frac{1\ gram}{1{,}000{,}000\ \mu g} \times \frac{3.785\ L}{gallon} \times \frac{Volume\ (gallons)}{454\ grams}$ = 0.05

0.50 µg/L - 1.0 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)	Mass of PCBs (pounds)
106,709	2	40 - 67	27	2,881,143	5,387,737	0.5	0.02

ƚ A porosity of 0.25 was used.

> 1.0 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)	Mass of PCBs (pounds)
219,663	5	40 - 67	27	5,930,901	11,090,785	1	0.09

ƚ A porosity of 0.25 was used.

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A.11.2 Calculate the volume and mass of total PCBs in intermediate groundwater (95 - 200 feet below ground surface)

*See Appendix Figure A-13 for area locations and calculated areas. The mean concentration used to calculate the mass of PCBs present in the aquifer was the outer boundary [i.e. 0.09 micrograms per liter (µg/L), 0.5 µg/L, or 1.0 µg/L]

0.09 µg/L - 0.5 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ᵻ	Mean Concentration (µg/L)	Mass of PCBs (pounds)
1,383,020	32	95 - 200	105	145,217,100	271,555,977	0.09	0.20

ᵻ A porosity of 0.25 was used.

Example Calculation: Volume of contaminated groundwater = Volume (ft^3) X 7.48 gallons/ft^3 X 0.25

Volume = 145,217,100 ft^3 X 7.48 X 0.25 = 271,555,977 gallons

Example calculation:

Mass of PCBs (lbs) = $\frac{0.09\ \mu g}{L}$ X $\frac{1\ gram}{1{,}000{,}000\ \mu g}$ X $\frac{3.785\ L}{gallon}$ X $\frac{Volume\ (gallons)}{}$ X $\frac{lbs}{454\ grams}$ = 0.20

0.50 µg/L - 1.0 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ᵻ	Mean Concentration (µg/L)	Mass of PCBs (pounds)
686,536	16	95 - 200	105	72,086,280	134,801,344	0.5	0.56

ᵻ A porosity of 0.25 was used.

> 1.0 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ᵻ	Mean Concentration (µg/L)	Mass of PCBs (pounds)
942,138	22	95 - 200	105	98,924,490	184,988,796	1	1.54

ᵻ A porosity of 0.25 was used.

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A.11.3 Calculate the volume and mass of total PCBs in deep groundwater (180 - 294 feet below ground surface)

*See Appendix Figure A-14 for area locations and calculated areas. The mean concentration used to calculate the mass of PCBs present in the aquifer was the outer boundary [i.e. 0.09 micrograms per liter (µg/L), 0.5 µg/L, or 1.0 µg/L]

0.09 µg/L - 0.5 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ł	Mean Concentration (µg/L)	Mass of PCBs (pounds)
267,053	6	180 - 294	114	30,444,042	56,930,359	0.09	0.04

ł A porosity of 0.25 was used.

Example Calculation: Volume of contaminated groundwater = Volume (ft^3) X 7.48 gallons/ft^3 X 0.25
Volume = 30,444,042 ft^3 X 7.48 X 0.25 = 56,930,359 gallons

Example calculation:
Mass of PCBs (lbs) = $\frac{0.09\ \mu g}{L} \times \frac{1\ gram}{1,000,000\ \mu g} \times \frac{3.785\ L}{gallon} \times \frac{Volume\ (gallons) \times lbs}{454\ grams}$ = 0.04

0.50 µg/L - 1.0 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ł	Mean Concentration (µg/L)	Mass of PCBs (pounds)
588,122	14	180 - 294	114	67,045,908	125,375,848	0.5	0.52

ł A porosity of 0.25 was used.

> 1.0 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ł	Mean Concentration (µg/L)	Mass of PCBs (pounds)
393,499	9	180 - 294	114	44,858,886	83,886,117	1	0.70

ł A porosity of 0.25 was used.

A.11.4 Calculate the volume and mass of total PCBs above 0.5 part per billion (µg/L) in groundwater:

0.50 µg/L

Volume Contaminated Groundwater = 545,530,627 gallons
SAY 550,000,000 gallons
= 3.44 pounds SAY 4 pounds

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A.12 CALCULATE THE VOLUME AND MASS OF HEXAVALENT CHROMIUM IN GROUNDWATER:

A.12.1 Calculate the volume and mass of hexavalent chromium (hex. chrome) in shallow groundwater (40 - 67 feet below ground surface)

*See Appendix Figure A-15 for area locations and calculated areas. Detections of hexavalent chromium (maximum current detected) were used to draw isocontours. Areas were calculated using GIS software.

50 µg/L - 100 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)	Mass of hexavalent chromium (pounds)
14,943	0.34	40 - 67	27	403,461	754,472	50	0.31

ƚ A porosity of 0.25 was used.

Example Calculation: Volume of contaminated groundwater = Volume (ft^3) X 7.48 gallons/ft^3 X 0.25

Volume = 403,461 ft^3 X 7.48 X 0.25 = 754,472 gallons

Example Calculation:

Mass of hex chrome (lbs) = $\frac{50\ \mu g}{L} \times \frac{1\ gram}{1{,}000{,}000\ \mu g} \times \frac{3.785\ L}{gallon} \times \frac{\text{Volume (gallons)}}{454\ grams}$ = 0.31

> 100 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)*	Mass of PCBs (pounds)
11,546	0.27	40 - 67	27	311,742	582,958	111	0.54

ƚ A porosity of 0.25 was used.

*Value is the maximum concentration within the contour.

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A.12.2 Calculate the volume and mass of hexavalent chromium (hex. chrome) in intermediate groundwater (95 - 200 feet below ground surface)

*See Appendix Figure A-16 for area locations and calculated areas. Detections of hexavalent chromium (maximum current detected) were used to draw isocontours. Areas were calculated using GIS software.

50 µg/L - 100 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)	Mass of hexavalent chromium (pounds)
45,615	1.0	95 - 200	105	4,789,575	8,956,505	50	3.73

ƚ A porosity of 0.25 was used.

Example Calculation: Volume of contaminated groundwater = Volume (ft^3) X 7.48 gallons/ft^3 X 0.25

Volume = 4,789,575 ft^3 X 7.48 X 0.25 = 8,956,505 gallons

Example Calculation:

$$\text{Mass of hex chrome (lbs)} = \frac{50\ \mu g}{L} \times \frac{1\ \text{gram}}{1{,}000{,}000\ \mu g} \times \frac{3.785\ L}{\text{gallon}} \times \frac{\text{Volume (gallons)}}{454\ \text{grams}} = 3.73$$

> 100 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ƚ	Mean Concentration (µg/L)*	Mass of PCBs (pounds)
11,979	0.28	95 - 200	105	1,257,795	2,352,077	188	3.69

ƚ A porosity of 0.25 was used.

*Value is equal to the highest concentration within the contour.

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A.12.3 Calculate the volume and mass of hexavalent chromium (hex. chrome) in deep groundwater (180 - 294 feet below ground surface)

*See Appendix Figure A-17 for area locations and calculated areas. Detections of hexavalent chromium (maximum current detected) were used to draw isocontours. Areas were calculated using GIS software.

50 µg/L - 100 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ɫ	Mean Concentration (µg/L)	Mass of hexavalent chromium (pounds)
435,226	10	180 - 294	114	49,615,764	92,781,479	50	38.68

ɫ A porosity of 0.25 was used.

Example Calculation: Volume of contaminated groundwater = Volume (ft^3) X 7.48 gallons/ft^3 X 0.25

Volume = 49,615,764 ft^3 X 7.48 X 0.25 = 92,781,479 gallons

Example Calculation:

Mass of hex chrome (lbs) = $\frac{50\ \mu g}{L} \times \frac{1\ gram}{1,000,000\ \mu g} \times \frac{3.785\ L}{gallon} \times \frac{Volume\ (gallons)}{454\ grams}$ = 38.68

> 100 µg/L

Area of Contour [square feet (ft^2)]	Area of Contour (acres)	Depth of Plume (feet below ground surface)	Thickness of Plume (feet)	Volume of Contour (ft^3)	Volume of Contaminted Groundwater (gallons)ɫ	Mean Concentration (µg/L)*	Mass of PCBs (pounds)
15,830	0.36	180 - 294	114	1,804,620	3,374,639	100	2.81

ɫ A porosity of 0.25 was used.

*Value is the highest concentration within the contour.

A.9.4 Calculate the total mass of hexavalent chromium in the 100 µg/L contour:

In an area of approximately 0.90 acres, there are approximately
6,309,674 million gallons, with
7.04 pounds of hexavalent chromium.
SAY 7 pounds in 6,400,000 million gallons

Note:
Areas and mean concentrations were calculated using GIS software

Legend

- Soil Boring Location
- 1 mg/kg contour at 0-2 feet bgs
- Attainment Area

0 50 100 Feet

Location	Attainment Area Area (sq feet)	1 mg/kg contour Area (sq feet)	1 mg/kg contour Mean PCB (mg/kg)
A-1	188,370	151,952	12.36
A-2	6,207	195	1.3

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PCB
0-2 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	**A-1**	REV	DATE 3/10/15

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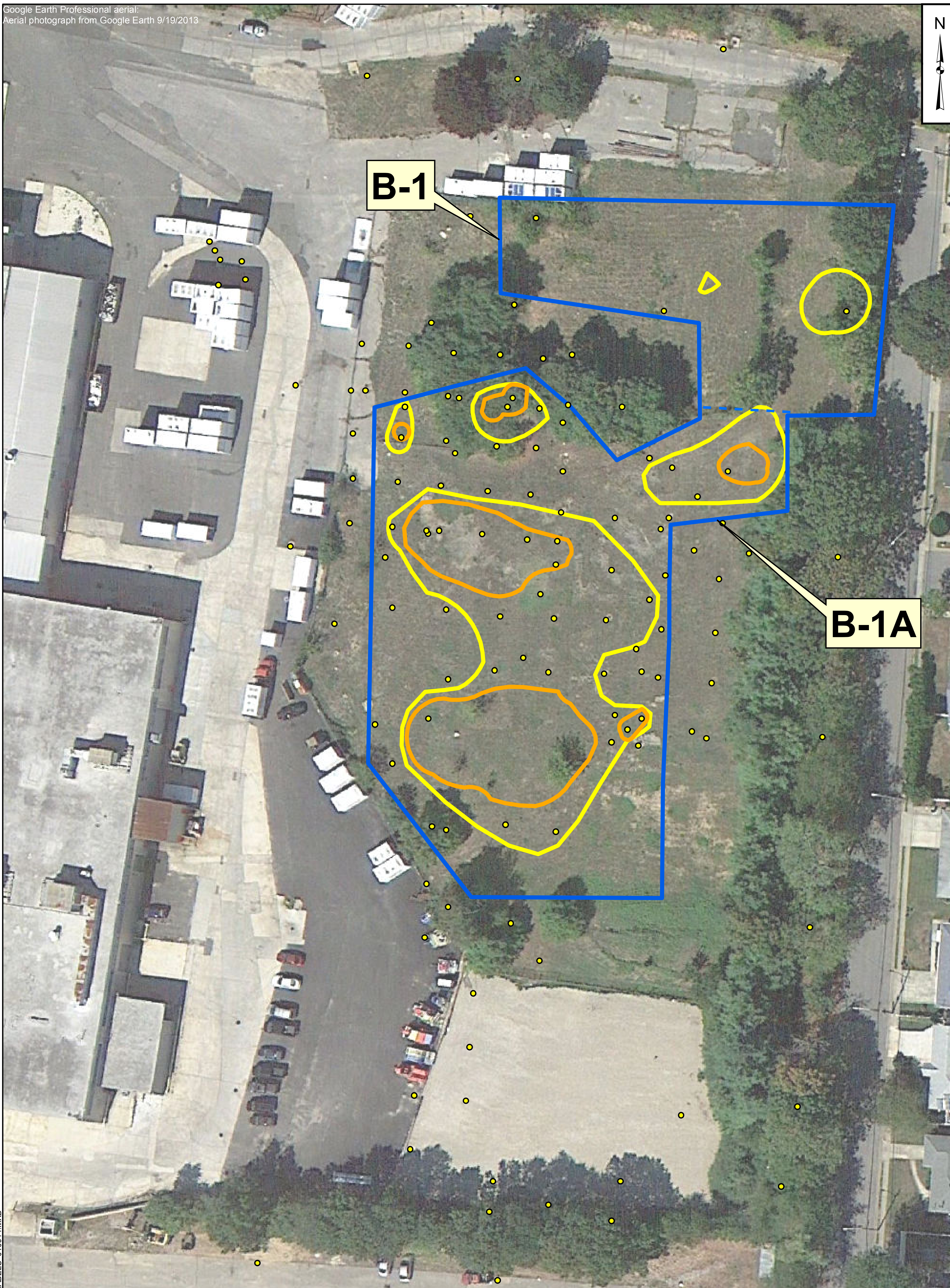

Note:
Areas and mean concentrations were calculated using GIS software

Legend

- Soil Boring Location
- 10 mg/kg contour at 2-10 feet bgs
- 25 mg/kg contour at 2-10 feet bgs
- Attainment Area

0 50 100 Feet

Location	Attainment Area Area (sq feet)	Area (sq feet)	Mean PCB (mg/kg)	Area (sq feet)	Mean PCB (mg/kg)
B-1 (>10 mg/kg)	65,695	24,599	44.94		
B-1A (>25 mg/kg)	46,854			9,328	91.78

TETRA TECH

PCB
2-10 foot
10 mg/kg & 25 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	A-2	REV	DATE 3/9/15

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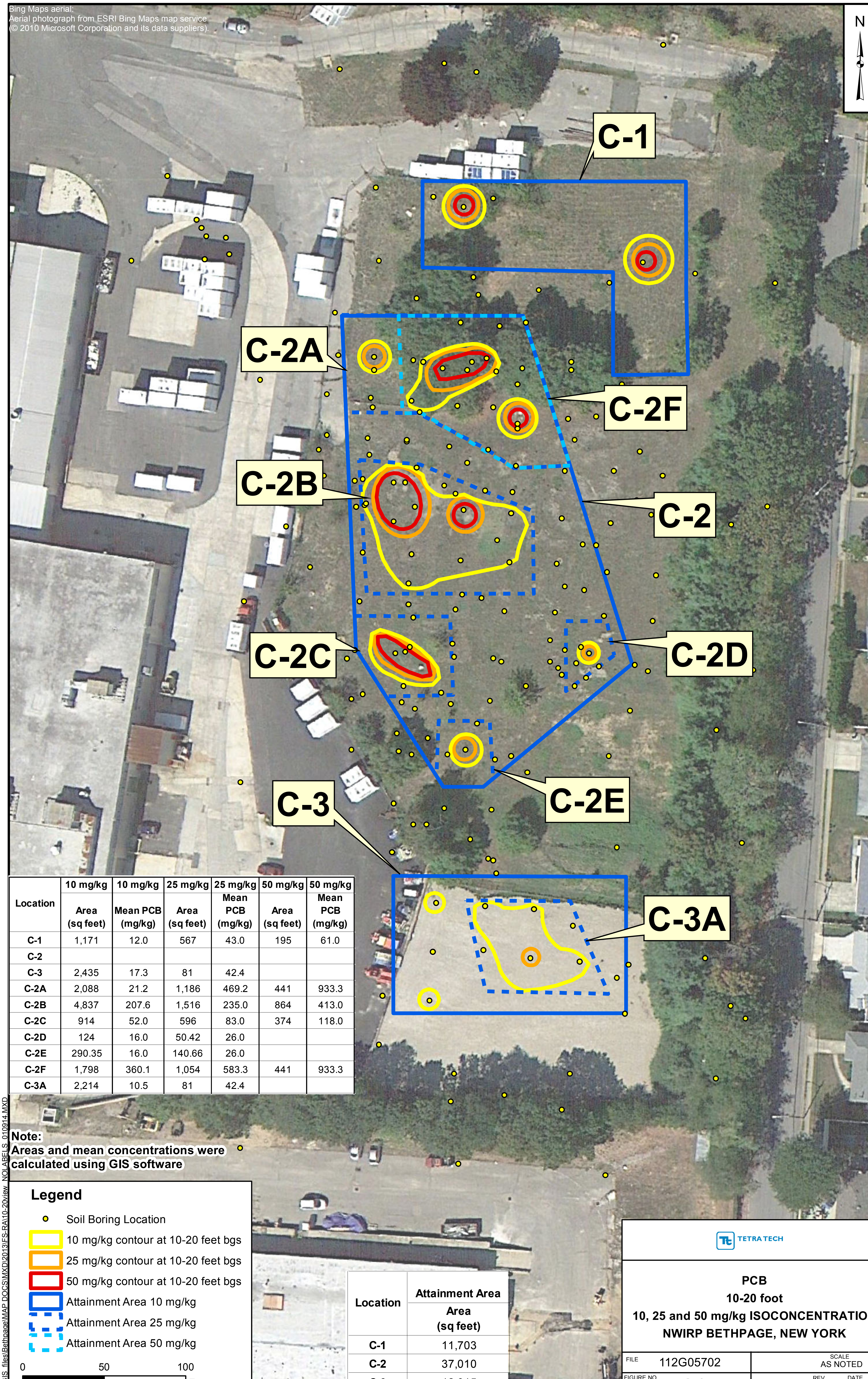

Location	10 mg/kg Area (sq feet)	10 mg/kg Mean PCB (mg/kg)	25 mg/kg Area (sq feet)	25 mg/kg Mean PCB (mg/kg)	50 mg/kg Area (sq feet)	50 mg/kg Mean PCB (mg/kg)
C-1	1,171	12.0	567	43.0	195	61.0
C-2						
C-3	2,435	17.3	81	42.4		
C-2A	2,088	21.2	1,186	469.2	441	933.3
C-2B	4,837	207.6	1,516	235.0	864	413.0
C-2C	914	52.0	596	83.0	374	118.0
C-2D	124	16.0	50.42	26.0		
C-2E	290.35	16.0	140.66	26.0		
C-2F	1,798	360.1	1,054	583.3	441	933.3
C-3A	2,214	10.5	81	42.4		

Note:
Areas and mean concentrations were calculated using GIS software

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Legend

- Soil Boring Location
- 10 mg/kg contour at 10-20 feet bgs
- 25 mg/kg contour at 10-20 feet bgs
- 50 mg/kg contour at 10-20 feet bgs
- Attainment Area 10 mg/kg
- Attainment Area 25 mg/kg
- Attainment Area 50 mg/kg

0 50 100 Feet

Location	Attainment Area Area (sq feet)
C-1	11,703
C-2	37,010
C-3	12,015

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PCB
10-20 foot
10, 25 and 50 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	A-3	REV	DATE 3/10/15

Location	10 mg/kg	10 mg/kg	25 mg/kg	25 mg/kg	50 mg/kg	50 mg/kg
	Area (sq feet)	Mean PCB (mg/kg)	Area (sq feet)	Mean PCB (mg/kg)	Area (sq feet)	Mean PCB (mg/kg)
D-1	5,956	300	3,384	474	1,688	671
D-2	1,851	39				
D-2A	1,276		624	62	321	87
D-2B	492		317	52	107	73

Note:
Areas and mean concentrations were calculated using GIS software

P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS-RA\20-30\VIEW_NOLABELS_010914.MXD

Legend

- Soil Boring Location
- 10 mg/kg contour at 20-30 feet bgs
- 25 mg/kg contour at 20-30 feet bgs
- 50 mg/kg contour at 20-30 feet bgs
- Attainment Area 25 mg/kg
- Attainment Area 10 mg/kg

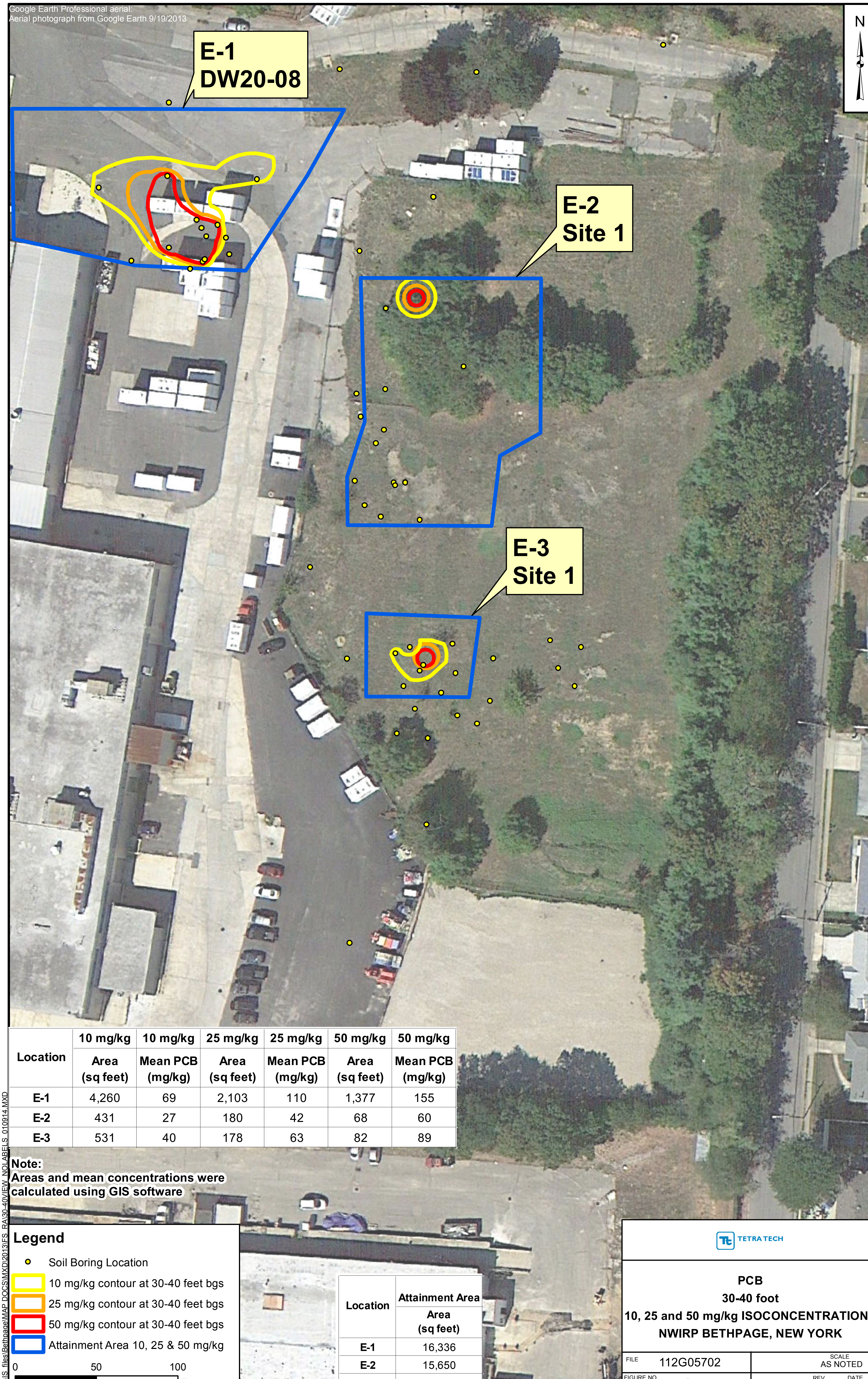
0 50 100 Feet

Location	Attainment Area Area (sq feet)
D-1	16,336
D-2	19,241
D-2A	11,710
D-2B	3,329

TETRA TECH

PCB
20-30 foot
10, 25 and 50 mg/kg ISOCONCENTRATIONS
NWIRP BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	A-4	REV	DATE 3/17/15



Location	10 mg/kg	10 mg/kg	25 mg/kg	25 mg/kg	50 mg/kg	50 mg/kg
	Area (sq feet)	Mean PCB (mg/kg)	Area (sq feet)	Mean PCB (mg/kg)	Area (sq feet)	Mean PCB (mg/kg)
E-1	4,260	69	2,103	110	1,377	155
E-2	431	27	180	42	68	60
E-3	531	40	178	63	82	89

Note:
Areas and mean concentrations were calculated using GIS software

Legend

- Soil Boring Location
- 10 mg/kg contour at 30-40 feet bgs
- 25 mg/kg contour at 30-40 feet bgs
- 50 mg/kg contour at 30-40 feet bgs
- Attainment Area 10, 25 & 50 mg/kg

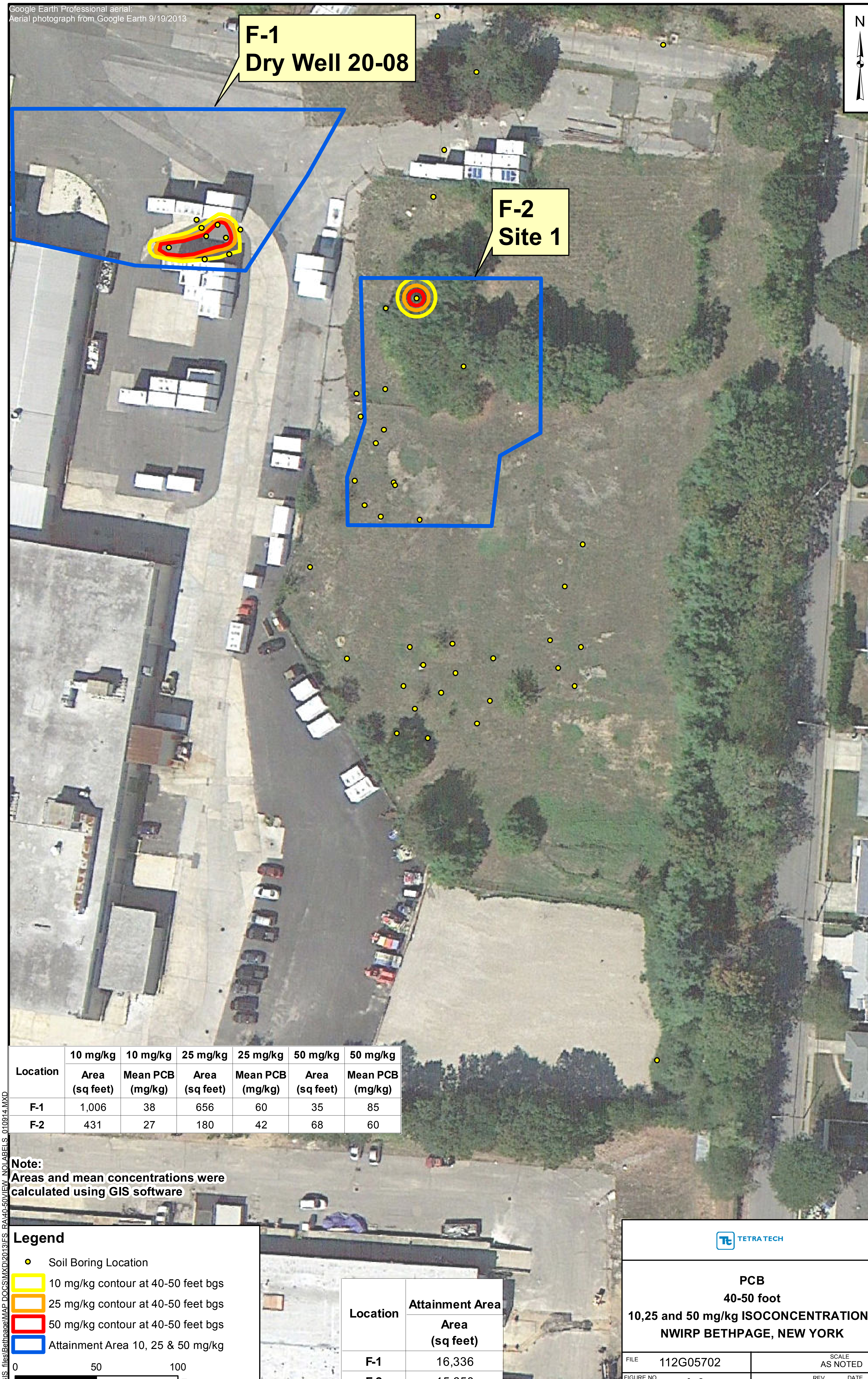
0 50 100 Feet

Location	Attainment Area
	Area (sq feet)
E-1	16,336
E-2	15,650
E-3	3,318

TETRA TECH

PCB
30-40 foot
10, 25 and 50 mg/kg ISOCONCENTRATIONS
NWIRP BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	A-5	REV	DATE 3/10/15



Location	10 mg/kg Area (sq feet)	10 mg/kg Mean PCB (mg/kg)	25 mg/kg Area (sq feet)	25 mg/kg Mean PCB (mg/kg)	50 mg/kg Area (sq feet)	50 mg/kg Mean PCB (mg/kg)
F-1	1,006	38	656	60	35	85
F-2	431	27	180	42	68	60

Note:
Areas and mean concentrations were calculated using GIS software

Location	Attainment Area (sq feet)
F-1	16,336
F-2	15,650

TETRA TECH

PCB
40-50 foot
10,25 and 50 mg/kg ISOCONCENTRATIONS
NWIRP BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	A-6	REV / DATE	3/9/15

Location	10 mg/kg Area (sq feet)	10 mg/kg Mean PCB (mg/kg)	25 mg/kg Area (sq feet)	25 mg/kg Mean PCB (mg/kg)	50 mg/kg Area (sq feet)	50 mg/kg Mean PCB (mg/kg)
G-1	912	51	521	81	115	114
G-2	5,633	22	4,210	35	1,437	50
G-3	384	43.34	211	65	55	82

Note:
Areas and mean concentrations were calculated using GIS software

Legend

- Soil Boring Location
- 10 mg/kg contour at 50-60 feet bgs
- 25 mg/kg contour at 50-60 feet bgs
- 50 mg/kg contour at 50-60 feet bgs
- Attainment Area10, 25 & 50 mg/kg

0 50 100 Feet

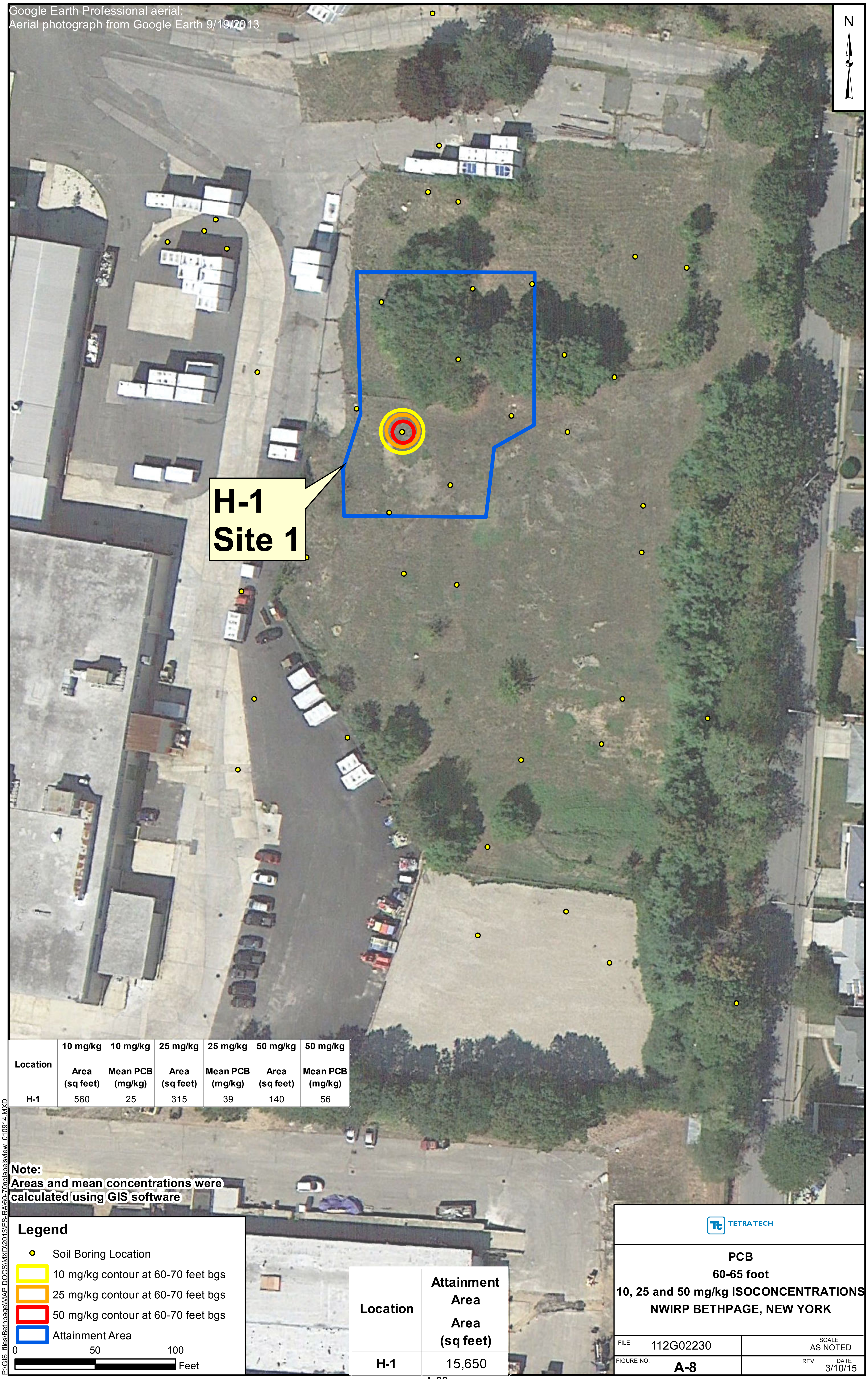
Location	Attainment Area Area (sq feet)
G-1	16,336
G-2	15,650
G-3	3,340

TETRA TECH

PCB
50-60 foot
10, 25 and 50 mg/kg ISOCONCENTRATIONS
NWIRP BETHPAGE, NEW YORK

FILE	112G05702	SCALE AS NOTED
FIGURE NO.	A-7	REV DATE 3/9/15

P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS_RA\50_60VIEW_NOLABELS_010914.MXD



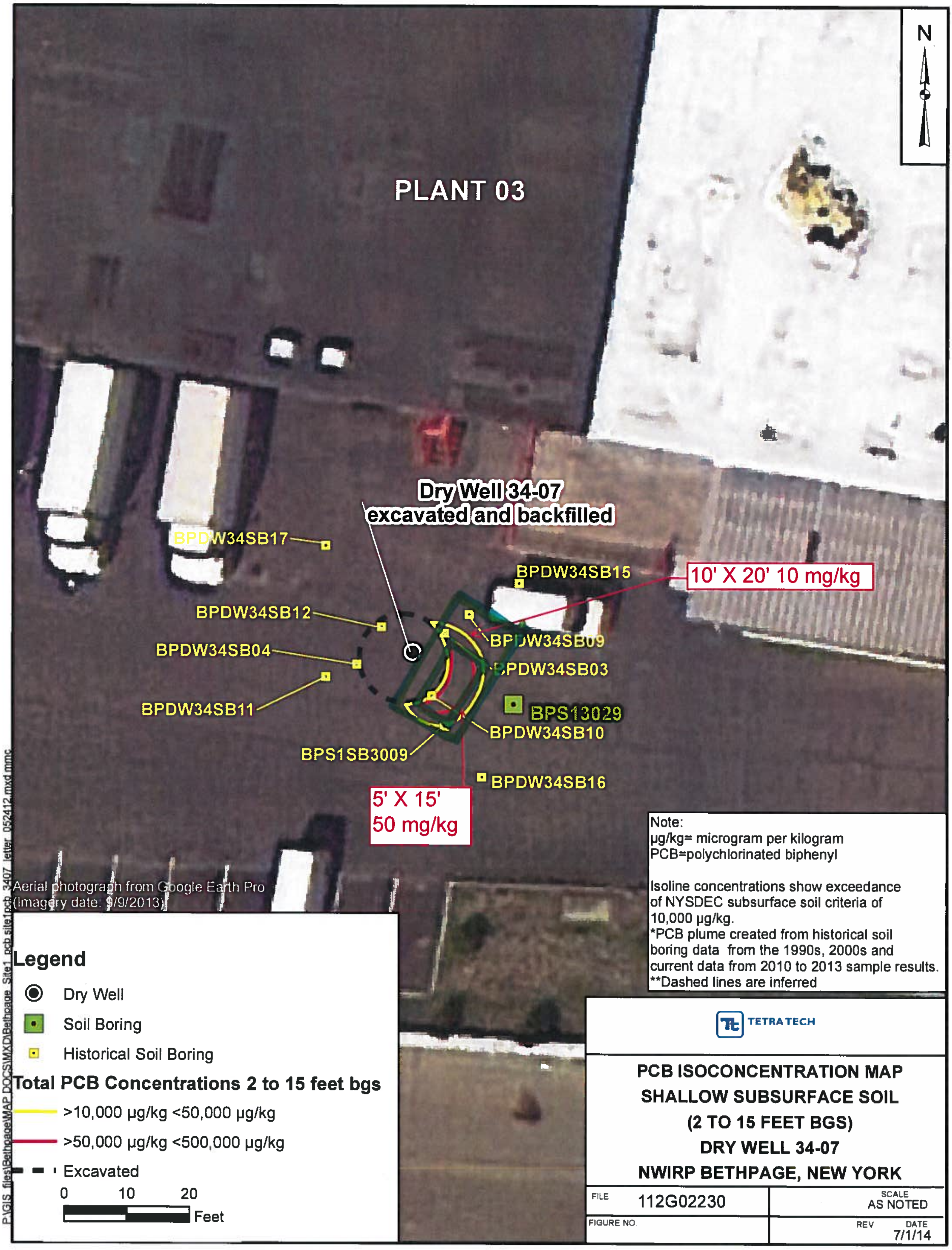
Location	10 mg/kg Area (sq feet)	10 mg/kg Mean PCB (mg/kg)	25 mg/kg Area (sq feet)	25 mg/kg Mean PCB (mg/kg)	50 mg/kg Area (sq feet)	50 mg/kg Mean PCB (mg/kg)
H-1	560	25	315	39	140	56

Location	Attainment Area Area (sq feet)
H-1	15,650

TETRA TECH

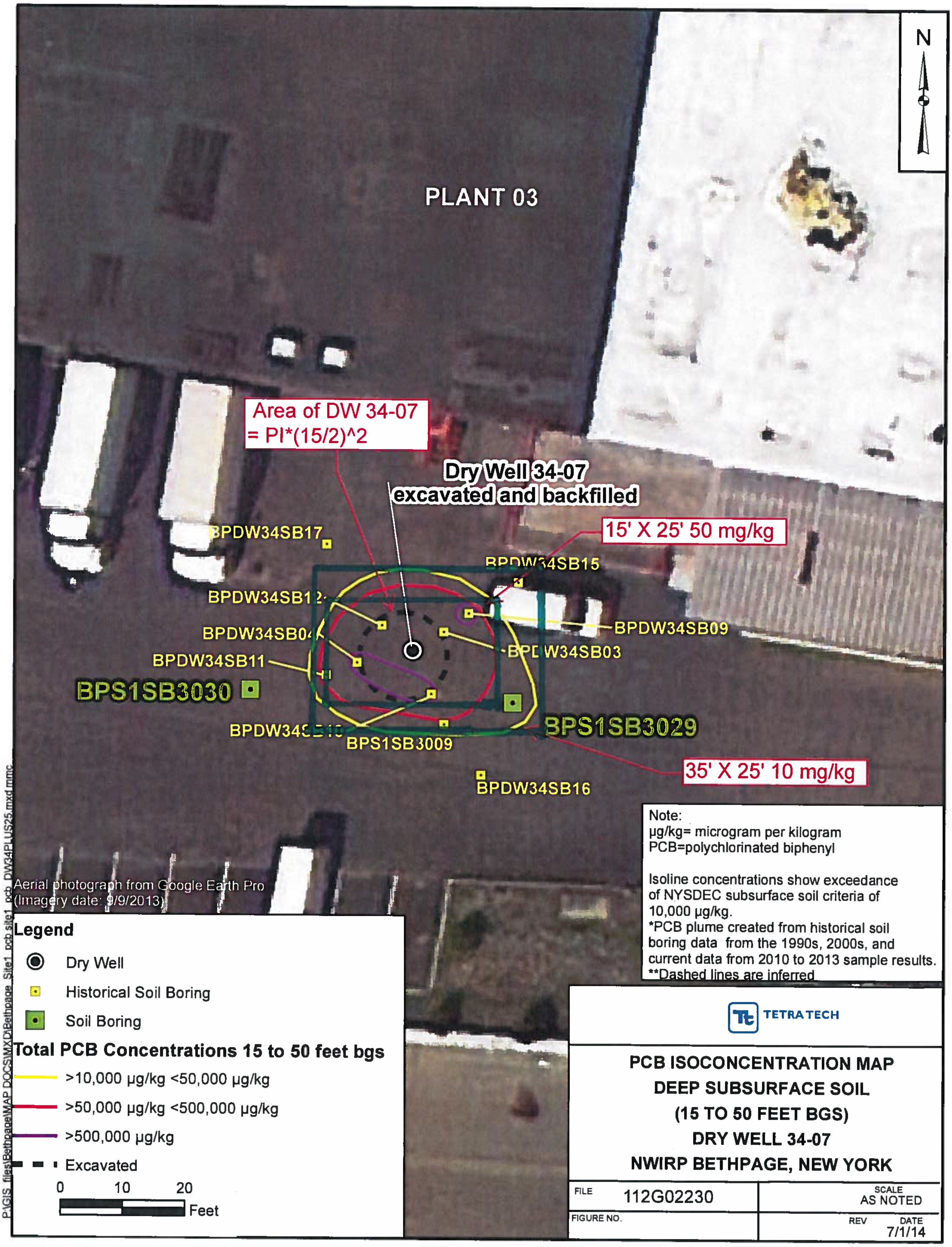
PCB
60-65 foot
10, 25 and 50 mg/kg ISOCONCENTRATIONS
NWIRP BETHPAGE, NEW YORK

FILE	112G02230	SCALE	AS NOTED
FIGURE NO.	A-8	REV / DATE	3/10/15



N
PLANT 03
Dry Well 34-07
excavated and backfilled
BPDW34SB17
BPDW34SB15
10' X 20' 10 mg/kg
BPDW34SB12
BPDW34SB09
BPDW34SB04
BPDW34SB03
BPDW34SB11
BPS13029
BPDW34SB10
BPS1SB3009
BPDW34SB16
5' X 15'
50 mg/kg
Aerial photograph from Google Earth Pro
(Imagery date: 9/9/2013)
Note:
µg/kg= microgram per kilogram
PCB=polychlorinated biphenyl
Isoline concentrations show exceedance of NYSDEC subsurface soil criteria of 10,000 µg/kg.
*PCB plume created from historical soil boring data from the 1990s, 2000s and current data from 2010 to 2013 sample results.
**Dashed lines are inferred
Legend
Dry Well
Soil Boring
Historical Soil Boring
Total PCB Concentrations 2 to 15 feet bgs
>10,000 µg/kg <50,000 µg/kg
>50,000 µg/kg <500,000 µg/kg
Excavated
0 10 20
Feet
TETRA TECH
PCB ISOCONCENTRATION MAP
SHALLOW SUBSURFACE SOIL
(2 TO 15 FEET BGS)
DRY WELL 34-07
NWIRP BETHPAGE, NEW YORK
FILE 112G02230
SCALE AS NOTED
FIGURE NO.
REV
DATE 7/1/14

Figure A-9



PLANT 03
N
Area of DW 34-07
= PI*(15/2)^2
Dry Well 34-07
excavated and backfilled
15' X 25' 50 mg/kg
BPDW34SB17
BPDW34SB09
BPDW34SB11
BPS1SB3030
BPS1SB3009
BPS1SB3029
35' X 25' 10 mg/kg
BPDW34SB16
Aerial photograph from Google Earth Pro
(Imagery date: 9/9/2013)
Note:
µg/kg= microgram per kilogram
PCB=polychlorinated biphenyl
Isoline concentrations show exceedance of NYSDEC subsurface soil criteria of 10,000 µg/kg.
*PCB plume created from historical soil boring data from the 1990s, 2000s, and current data from 2010 to 2013 sample results.
**Dashed lines are inferred
Legend
Dry Well
Historical Soil Boring
Soil Boring
Total PCB Concentrations 15 to 50 feet bgs
>10,000 µg/kg <50,000 µg/kg
>50,000 µg/kg <500,000 µg/kg
>500,000 µg/kg
Excavated
0 10 20
Feet
TETRA TECH
PCB ISOCONCENTRATION MAP
DEEP SUBSURFACE SOIL
(15 TO 50 FEET BGS)
DRY WELL 34-07
NWIRP BETHPAGE, NEW YORK
FILE 112G02230
SCALE AS NOTED
FIGURE NO.
REV
DATE 7/1/14

Figure A-10

Note:
µg/kg= microgram per kilogram
PCB=polychlorinated biphenyl

Isoline concentrations show exceedance of NYSDEC subsurface soil criteria of 10,000 µg/kg.
*PCB plume created from historical soil boring data from the 1990s, 2000s, and current data from 2010 to 2013 sample results.
**Dashed lines are inferred

TETRA TECH

PCB ISOCONCENTRATION MAP
DEEP SUBSURFACE SOIL
50 to 54 FEET BGS)
DRY WELL 34-07
NWIRP BETHPAGE, NEW YORK

FILE 112G02230	SCALE AS NOTED
FIGURE NO.	REV DATE 10/15/14

P:\GIS_files\Bethpage\MAP DOCS\MXD\Bethpage_Site1_pcb\site1_pcb_DW34PLUS50.mxd mmc

Figure A-11

Shallow PCB-Isoconcentration

0.09 µg/L - 1,681,806 sq ft
0.50 µg/L - 326,372 sq ft
1.0 µg/L - 219,663 sq ft

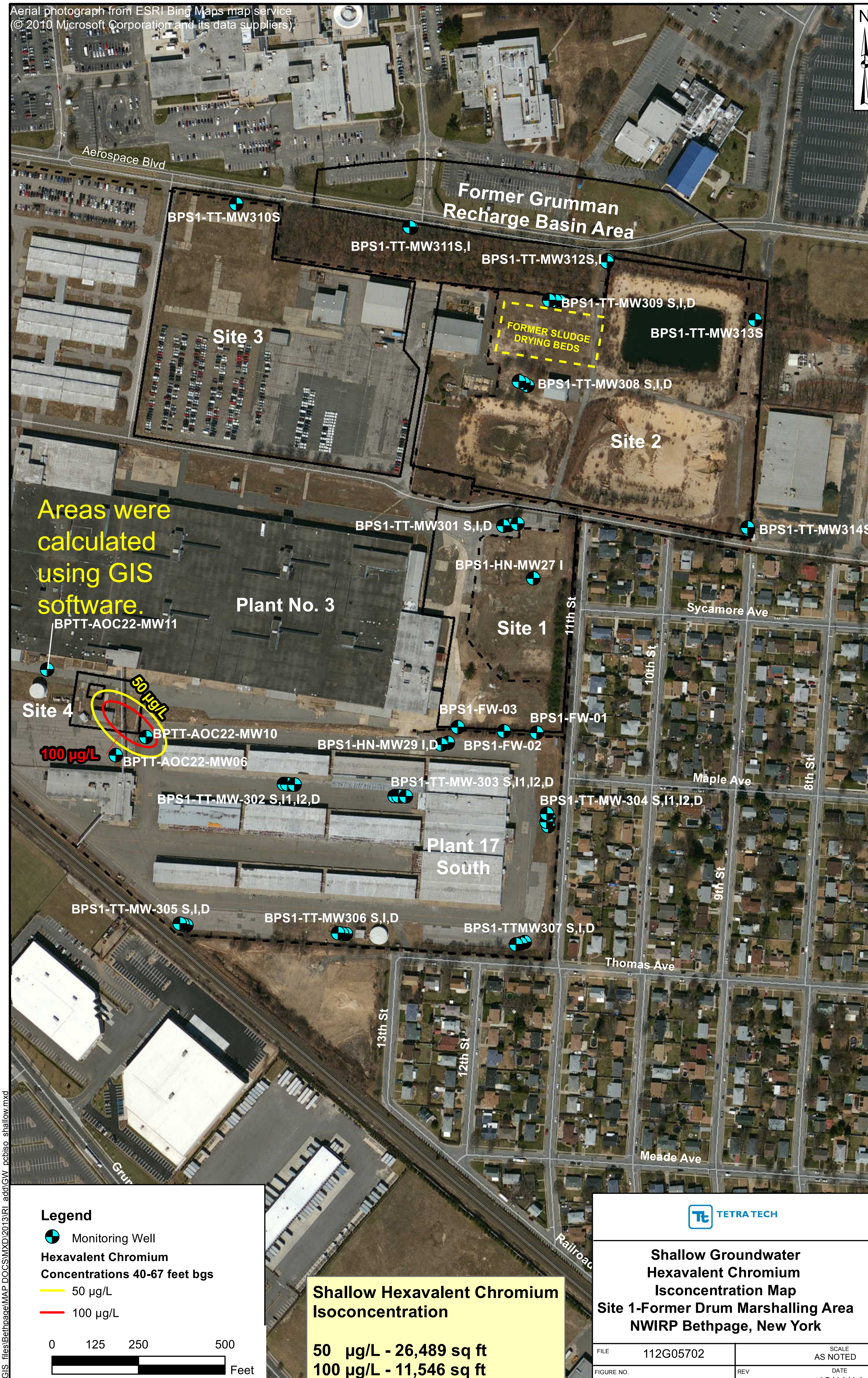
TETRA TECH

Shallow Groundwater PCB Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage
Bethpage,New York

FILE 112G02230		SCALE AS NOTED
FIGURE NO.	REV	DATE 1/5/15

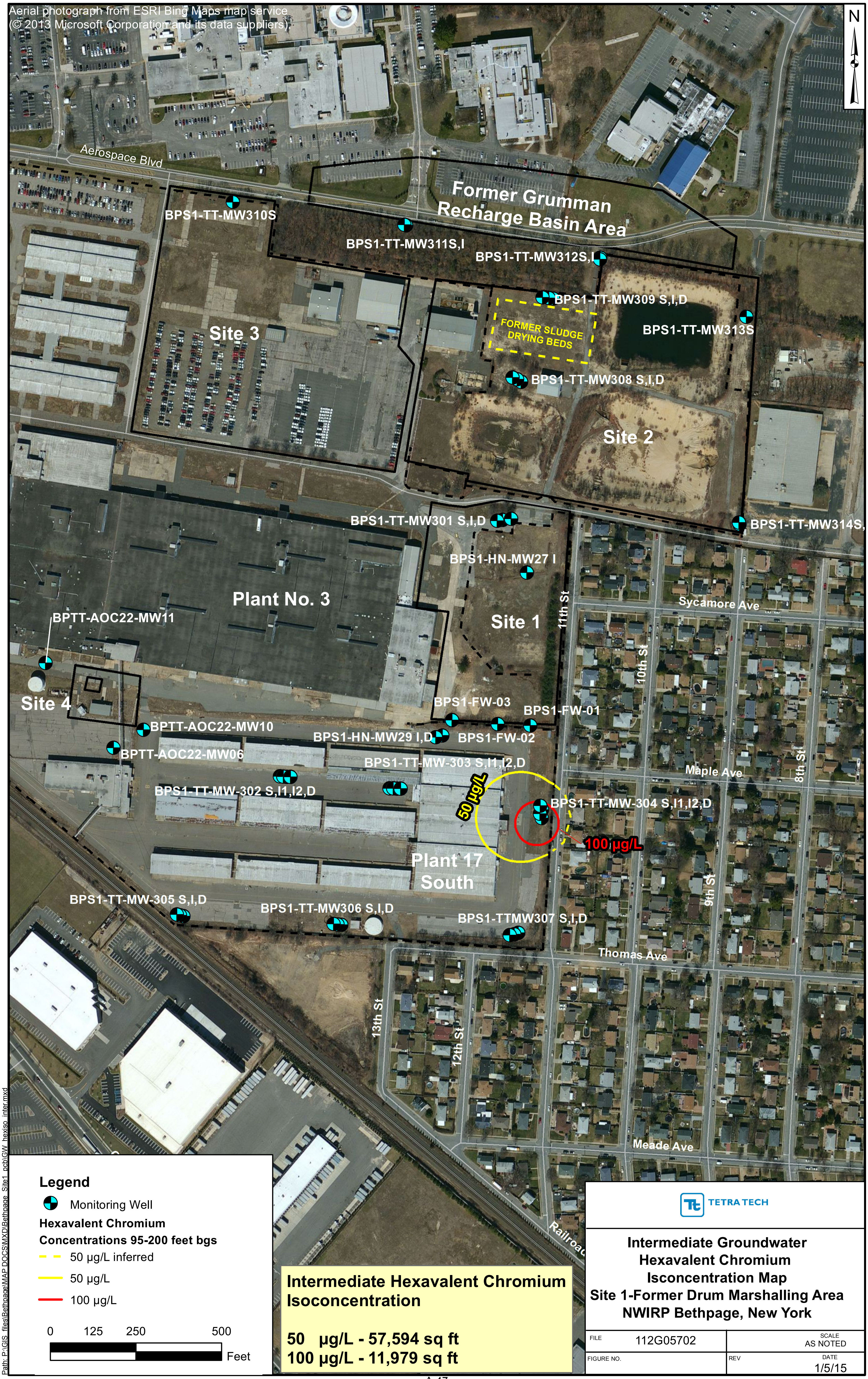
Aerial photograph from ESRI Bing Maps map service
(© 2010 Microsoft Corporation and its data suppliers)
N
Aerospace Blvd
0.09 µg/L
Former Grumman Recharge Basin Area
BPS1-TT-MW310S
BPS1-TT-MW311S,I
BPS1-TT-MW312S,I
BPS1-TT-MW309 S,I,D
FORMER SLUDGE DRYING BEDS
BPS1-TT-MW313S
Site 3
BPS1-TT-MW308 S,I,D
0.5 µg/L
Site 2
Areas were calculated using GIS software.
BPS1-TT-MW301 S,I,D
BPS1-TT-MW314S,
BPS1-HN-MW27 I
Sycamore Ave
Plant No. 3
1.0 µg/L
Site 1
11th St
10th St
BPTT-AOC22-MW11
Site 4
BPS1-FW-03
BPS1-FW-01
BPTT-AOC22-MW10
BPS1-HN-MW29 I,D
BPS1-FW-02
BPTT-AOC22-MW06
Maple Ave
8th St
BPS1-TT-MW-303 S,I1,I2,D
BPS1-TT-MW-302 S,I1,I2,D
BPS1-TT-MW-304 S,I1,I2,D
Plant 17 South
9th St
BPS1-TT-MW-305 S,I,D
BPS1-TT-MW306 S,I,D
BPS1-TTMW307 S,I,D
Thomas Ave
13th St
12th St
Meade Ave
Railroad
Legend
Monitoring Well
PCB Concentrations 95-200 Feet bgs
0.09 µg/L (inferred)
0.5 µg/L (inferred)
0.5 µg/L
1.0 µg/L (inferred)
1.0 µg/L
0 125 250 500
Feet
P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\RI_add\GW_pcbiso_intermediate.mxd
Intermediate PCB-Isoconcentration
0.09 µg/L - 3,011,694 square feet
0.50 µg/L - 1,628,674 square feet
1.0 µg/L - 942,138 square feet
TETRA TECH
Intermediate Groundwater
PCB Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage
Bethpage,New York
FILE 112G02230
SCALE AS NOTED
FIGURE NO.
REV
DATE 1/5/15


Aerial photograph from ESRI Bing Maps map service
(© 2013 Microsoft Corporation and its data suppliers)
N
Aerospace Blvd
Former Grumman Recharge Basin Area
BPS1-TT-MW310S
BPS1-TT-MW311S,I
BPS1-TT-MW312S,I
BPS1-TT-MW309 S,I,D
BPS1-TT-MW313S
FORMER SLUDGE DRYING BEDS
Site 3
BPS1-TT-MW308 S,I,D
Site 2
0.09 µg/L
0.5 µg/L
Areas were calculated using GIS software.
BPS1-TT-MW301 S,I,D
BPS1-TT-MW314S,
BPS1-HN-MW27 I
Sycamore Ave
Plant No. 3
Site 1
11th St
10th St
BPTT-AOC22-MW11
Site 4
BPS1-FW-03
BPS1-FW-01
BPTT-AOC22-MW10
BPS1-HN-MW29 I,D
BPS1-FW-02
BPTT-AOC22-MW06
1.0 µg/L
BPS1-TT-MW-303 S,I1,I2,D
Maple Ave
8th St
BPS1-TT-MW-302 S,I1,I2,D
BPS1-TT-MW-304 S,I1,I2,D
Plant 17 South
9th St
BPS1-TT-MW-305 S,I,D
BPS1-TT-MW306 S,I,D
BPS1-TTMW307 S,I,D
Thomas Ave
13th St
12th St
Meade Ave
Railroad
Legend
Monitoring Well
PCB Concentrations 180-294 Feet bgs
0.09 µg/L
0.09 µg/L (inferred)
0.5 µg/L
0.5 µg/L (inferred)
1.0 µg/L
1.0 µg/L (inferred)
0 125 250 500
Feet
Deep PCB-Isoconcetration
0.09 µg/L - 1,248,674 square feet
0.50 µg/L - 981,621 square feet
1.0 µg/L - 393,499 square feet
TETRA TECH
Deep Groundwater
PCB Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage
Bethpage,New York
FILE
112G02230
SCALE
AS NOTED
FIGURE NO.
REV
DATE
1/5/15
P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\RI_add\GW_pcbiso_deep.mxd 110113



Aerial photograph from ESRI Bing Maps map service
(© 2010 Microsoft Corporation and its data suppliers).
N
Aerospace Blvd
Former Grumman
Recharge Basin Area
BPS1-TT-MW310S
BPS1-TT-MW311S,I
BPS1-TT-MW312S,I
BPS1-TT-MW309 S,I,D
BPS1-TT-MW313S
FORMER SLUDGE
DRYING BEDS
Site 3
BPS1-TT-MW308 S,I,D
Site 2
Areas were calculated using GIS software.
BPS1-TT-MW301 S,I,D
BPS1-TT-MW314S,
BPS1-HN-MW27 I
Plant No. 3
Site 1
11th St
Sycamore Ave
10th St
BPTT-AOC22-MW11
Site 4
50 µg/L
100 µg/L
BPTT-AOC22-MW10
BPTT-AOC22-MW06
BPS1-FW-03
BPS1-FW-01
BPS1-HN-MW29 I,D
BPS1-FW-02
Maple Ave
8th St
BPS1-TT-MW-303 S,I1,I2,D
BPS1-TT-MW-302 S,I1,I2,D
BPS1-TT-MW-304 S,I1,I2,D
Plant 17
South
9th St
BPS1-TT-MW-305 S,I,D
BPS1-TT-MW306 S,I,D
BPS1-TTMW307 S,I,D
Thomas Ave
13th St
12th St
Meade Ave
Railroad
Legend
Monitoring Well
Hexavalent Chromium
Concentrations 40-67 feet bgs
50 µg/L
100 µg/L
0 125 250 500
Feet
Shallow Hexavalent Chromium
Isoconcentration
50 µg/L - 26,489 sq ft
100 µg/L - 11,546 sq ft
TETRA TECH
Shallow Groundwater
Hexavalent Chromium
Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage, New York
FILE 112G05702
SCALE AS NOTED
FIGURE NO.
REV
DATE 12/11/14
P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\RI_add\GW_pcbiso_shallow.mxd

Figure A-15


Aerial photograph from ESRI Bing Maps map service
(© 2013 Microsoft Corporation and its data suppliers).
N
Aerospace Blvd
Former Grumman Recharge Basin Area
BPS1-TT-MW310S
BPS1-TT-MW311S,I
BPS1-TT-MW312S,I
BPS1-TT-MW309 S,I,D
FORMER SLUDGE DRYING BEDS
BPS1-TT-MW313S
Site 3
BPS1-TT-MW308 S,I,D
Site 2
BPS1-TT-MW301 S,I,D
BPS1-TT-MW314S,
BPS1-HN-MW27 I
Sycamore Ave
Plant No. 3
Site 1
11th St
10th St
BPTT-AOC22-MW11
Site 4
BPS1-FW-03
BPS1-FW-01
BPTT-AOC22-MW10
BPS1-HN-MW29 I,D
BPS1-FW-02
BPTT-AOC22-MW06
BPS1-TT-MW-303 S,I1,I2,D
Maple Ave
8th St
BPS1-TT-MW-302 S,I1,I2,D
50 µg/L
BPS1-TT-MW-304 S,I1,I2,D
100 µg/L
Plant 17 South
9th St
BPS1-TT-MW-305 S,I,D
BPS1-TT-MW306 S,I,D
BPS1-TTMW307 S,I,D
Thomas Ave
13th St
12th St
Meade Ave
Railroad
Legend
Monitoring Well
Hexavalent Chromium Concentrations 95-200 feet bgs
50 µg/L inferred
50 µg/L
100 µg/L
0 125 250 500
Feet
Intermediate Hexavalent Chromium Isoconcentration
50 µg/L - 57,594 sq ft
100 µg/L - 11,979 sq ft
TETRA TECH
Intermediate Groundwater Hexavalent Chromium Isconcentration Map Site 1-Former Drum Marshalling Area NWIRP Bethpage, New York
FILE 112G05702
SCALE AS NOTED
FIGURE NO.
REV
DATE 1/5/15

Deep Groundwater
Hexavalent Chromium
Isconcentration Map
Site 1-Former Drum Marshalling Area
NWIRP Bethpage, New York

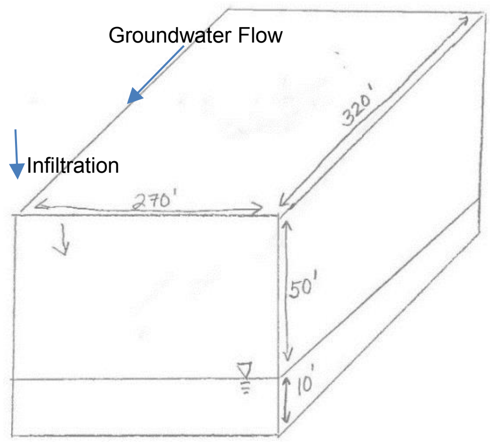
FILE 112G05702	SCALE AS NOTED
FIGURE NO.	REV	DATE 12/12/14

Figure A-17

APPENDIX B

ALTERNATIVE-SPECIFIC CALCULATIONS

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix B Site-Specific Dilution Factor		CHECKED BY:	DATE: 10/5/2015



B.1.0 SITE-SPECIFIC SOIL TO GROUNDWATER ATTENUATION FACTOR

Approach: Assume that PCBs partitioned on soil particles migrate to groundwater via precipitation

Site Properties

10 mg/kg contaminated soil dimensions = 270 feet (Width) by 320 feet (Length)

Unsaturated depth = 50 feet

Total volume of soil: **160,000 CY**

B.1.1 Determine Groundwater Flow through the area:

Model: groundwater flowing through the area, mixes with precipitation infiltration

Kh = 57 feet/day, from 1994 FS Report

gradient, using wells BPS1-TT-MW301S, BPS1-TT-MW303S = $\dfrac{\text{72.37 feet = 71.26 feet}}{\text{750 feet}}$

gradient (i)= 0.0015 feet/foot

Kh = 57 feet/day

saturated plume thickness = 10 foot/foot

Cross Sectional Area = , = 270 feet X 10 feet = 2,700 ft^2

$Q_{groundwater}$ = 57 feet/day X 0.0015 foot/foot X 2,700 ft^2 = **231 ft^3/day**

B.1.2 Determine Infiltration from Precipitation:

Precipitation Infiltration = 42 inches per year = 0.0096 foot/day

Area of Infiltration = Source Area = 270 feet by 320 feet = 86,400 ft^2

Assume 75% infiltration of precipitation, from sandy soils with high permeability and limited vegetation.

$Q_{infiltration}$ = Precipitation Infiltration * Area *0.75 = 620 ft^3/day

Net Flow of Groundwater = Infiltration + Groundwater Flow = 850 ft^3/day

Attenuation Factor due to mixing: 1.37

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix B Alternative Calculations Soil Alternative S-2 Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

B.S2-1 Purpose: Calculate the volume of soil to be excavated if soils are removed above 10 mg/kg to a depth of approximately 10 feet below ground surface (bgs) to account for a cover, and the amount of material needed for a permeable cover.

B.S2-2 Approach: Use volume estimates from Appendix A to estimate soil to be removed, and a thickness of two inches to estimate the volume of material required for a permeable cover.

B.S2-3 Estimate the volume of soil to be removed. Note that all soils are unsaturated (water table is located at an approximate depth of 50 feet bgs).

Volume of soil to balance a 2-foot cover =	195,000 ft^2 X 2' =	390,000 ft^3	
=	14,444 CuYds; SAY	**14,500 CuYds**	

Soil Excavation Depth required to balance 2-foot cover (2 to 10 foot interval)

Use the average of the area between the known (contours) and potential (attainment) area of soil contamination (Fig A-2)= 45,146 SF

8.6 Feet bgs

Say **9 Feet bgs**

Additional soil to be moved at the site (and consolidated under cover)

Windrow volume = Volume of a Trapezoidal Prism = V = LH*(A+B)/2 =

L =	450 feet
H =	5 feet
A =	23 feet
B =	3 feet

Volume Fill Material (Minus 6 inches topsoil)= 24,300 ft^3 = 900 CuYds

Volume Top Soil = 4950 ft^3 = 183 CuYds

Total Mass of PCBs Removed = A.8.1+A.8.2 = 1,412 lbs, SAY 1,400 lbs

B.S2-4 Trucking Removal Estimates (Amount to be Removed from the Site):

Tons Soil Removed = CuYds X 1.5 =	21,750 Tons
Using 15-ton trucks for removal, would use:	1,450 trucks
Estimate 8 trucks removed per day:	181 days

Volume of concrete (cesspools tops, settling tank)= 1,883 Tons (120 x 9 ft x 31 ft x 0.75 ft)

Say 1,900 Tons

B.S2-5 Estimate the amount of material required for a 2-foot gravel/soil cap:

Assume 6 inches of gravel cover =	195,000 ft^2	3,611 CuYds	gravel
Assume 18 inches of fill material =	195,000 ft^2	10,833 CuYds	fill material
Assume area to be cleared =	195,000 ft^2		

*Note that four groundwater monitoring wells (BPS1-TT-MW301 S, I, and D, and BPS1-HN-MW27I) will be removed and replaced during the excavation.

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix B Alternative Calculations Soil Alternative S-3 Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

B.S3-1 PURPOSE: Calculate the volume of soil to be excavated if soils are removed to account for a 5-foot RCRA cap.

B.S3-2 Approach: Use established cap design standards to estimate the required material for a cap.

B.S3-3 Estimate the volume of soil to be removed. Note that all soils are unsaturated (water table is located at an approximate depth of 50 feet bgs).

Volume of soil to balance a 5-foot cover =	195,000 ft^2 X 5' =	975,000 ft^3	
=		**36,111 CY**	
	which is too high.		
Limit excavation and offsite disposal to 1 foot =	195,000 ft^2 X 1' =	195,000 ft^3	
		7,222 CY	
	Say	**7,200 CY**	

Total Mass of PCBs Removed = 70% of A.8.1+A.8.3 =	1,062 lbs, SAY	**1,100 lbs**

Windrow volume = Volume of a Trapezoidal Prism = V = LH*(A+B)/2 =

L =	450 feet
H =	5 feet
A =	23 feet
B =	3 feet

B.S3-4 Trucking Removal Estimates (Amount to be Removed from the Site):

Tons Soil Removed = CuYds X 1.5 =		10,833 Tons
Using 15-ton trucks for removal, would use:	722 trucks	
Estimate 8 trucks removed per day:	90 days	

B.S3-5 Estimate the amount of material required for a RCRA cap:

Assume the RCRA cap covers the area of contaminated soils plus an additional 2 feet beyond contamination boundaries (using 0 - 2 boundary at 188,370 ft^2 (Figure A-1), round to 195,000 ft^2).

Gas Vent to be installed in natural material.

Geotextiles (above waste, above and below drainage layer)

ft^2= 200,000 = 22,222 sy

Low-permeability composite clay/geosynthetic liner]

ft^2= 200,000 X 2 feet compacted clay = 400,000 ft^3 = 14,815 CY

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	Drainage layer [gravel/sandy gravel] 1' thick			
ft^2=	200,000 X 1 feet compacted gravel	200,000 ft^3 =	7,407	CY
	Soil layer (loam, 1.5' thick			
ft^2=	200,000 X 1.5 feet =	300,000 ft^3 =	11,111	CY
	Vegetative cover, 6 inches			
ft^2=	200,000 X 6 inches =	100,000 ft^3 =	3,704	CY
		total	37,037	CY
Fine grading and seeding (lime, fertilizer, seed)=		200,000 ft^2 =	22,222	SY

Gravel or gravel and asphalt to be installed above cap where needed for parking.

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B.S4-1 PURPOSE: Determine the requirements for installing a vertical barrier at Site 1 to a depth of 80 feet.

B.S4-2 Approach: Use volume estimates from previous calculations to estimate soil to be removed, and established cap design standards to estimate the required material for a cap. Calculate the linear feet required to establish a vertical barrier.

B.S4-3 Estimate the volume of soil to be removed. See Alternative S-3 calculations for soil removal estimates, trucking estimates, and sheet piling sections.

*Note that four groundwater monitoring wells (BPS1-TT-MW301 S, I, and D, and BPS1-HN-MW27I) will be removed and replaced during the excavation.

B.S4-4 Estimate the amount of material required for a RCRA cap.
See Alternative S-3 (B.S3-5) for RCRA cap material estimates.

B.S4-5 Estimate the linear feet required to establish a vertical barrier around Site 1.

See Figure S4-1 for an estimated boundary (based on the area of PCBs greater than 10 mg/kg from 0 to 2 feet bgs). One inch equals approximately 40 feet.

Total linear feet :		1,650	feet	Site 1 plus Dry Well 20-08 No barrier at Dry Well 34-07
Total depth of barrier:	80 feet bgs			
Using 3 foot columns (jet grout):		550	columns	
With overlay:		1,100	columns	
Estimated No. of columns per day=		2		
construction duration =		27.5	months	
Use		**30**	**months.**	

For an estimated volume, with 2 rows of 3 foot diameter columns, to a depth of 80 feet bgs:

Volume = 622,035 ft^3 = 23,038 cy

Cement needed to former columns = 40% of volume, 9,215 cy

Treatment rate (23,038 cy over 27.5 months) = 838 cy/month.

Assume a volume increase of 15% that needs to be handled.
(additional for off site disposal).

3,456 CY

Say 3,500 CY

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B.S5A-1 PURPOSE: Calculate the volume of soil to be excavated if soils are removed above 25 mg/kg to a depth of 10 feet below ground surface, a RCRA cap is put in place, and solidification of soils over 50 mg/kg occurs, from 10 to 65 feet bgs.

B.S5A-2 Approach: Use volume estimates from previous calculations to estimate soil to be removed, and established cap design standards to estimate the required material for a cap. Calculate the linear feet required to establish a vertical barrier. Using volume estimates, identify design requirements for solidification of soils.

B.S5A-3 Estimate the volume of soil to be removed. See Alternative S-3 calculations (B.S3-3 - B.S3-4) for soil removal estimates, trucking estimates, and sheet piling sections.

*Note that four groundwater monitoring wells (BPS1-TT-MW301 S, I, and D, and BPS1-HN-MW27I) will be removed and replaced during the excavation.

B.S5A-4 Estimate the amount of material required for a RCRA cap.
See Alternative S-3 (B.S3-5) for RCRA cap material estimates.

B.S5A-6 Estimate the number of vertical columns required for in-situ solidification based on treatment areas (per depth above 50 mg/kg), and length of columns (depth of treatment area).
Value includes Site 1, Dry Well 20-08, and Dry Well 34-07.

Treatment Area Thickness (ft)	Treatment Area (ft^2)	Column Diameter 3 feet (sf)	Number of Columns Required (3-foot diam)	Volume Required for Sampling (ft^3)	Volume Required for Treatment (20%) (cy)	Mass of Required Bent/ Cement (ton)
54	29,135	7.069	1,236	1,573,280	11,654	4,662
60	7,081	7.069	300	424,830	3,147	1,259
14	11,686	7.069	496	163,610	1,212	485
48	875	7.069	37	42,000	311	124
		Total	2,070	2,203,720	16,324	6,530

Volume for Testing		81,619	cy
Number of samples (20 ft x 20 ft x 10 feet or 150 cy)		544	samples
	Say	**540**	**samples**

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Estimed volume for treatment (10 to 30%, use 20%):		16,324	cy
	Say	**16,000**	**cy**
Time required (@ 840 cy per month)		19	months
	Say	21	months
Cement neeed equals 40% of treatment volume.		6,400	cy

Areas are from Figure 5-5
The treatment areas are conservative boundaries for contaminated area and overestimate the horizontal and vertical boundaries of contaminants requiring treatment.

During design, an extensive sampling program would be conducted to delineate the extent of treatment (e.g., 4,000 cf or 150 cy), which is assumed to reduce the volume in half.

Thickness of 54 feet is solidification from 16 to 70 feet (Site 1 within excavation area)

Thickness of 60 feet is solidification from 10 to 70 feet (Dry Well 20-08)

Thickness of 14 feet is solidification from 2 to 16 feet (Site 1 outside excavation area)

Thickness of 48 feet is solidification from 2 to 50 feet (Dry Well 34-07)

Mass of cement is 50 pounds per CF or 1350 pounds per CY

An average density of 160 lb/ft^3 was used for portland cement.

Additional volume for offsite disposal (15%): **2,400 cy**

B.S5A-7 Estimate the Volume and Mass of PCBs treated via in-situ solidification.

Total Mass of PCBs Treated (use the 25 mg/kg) = 3,300 lbs

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B.S5B-1 Purpose: Calculate the volume of soil to be excavated if soils are removed above 25 mg/kg to a depth of 10 feet below ground surface, a RCRA cap is put in place, a vertical barier is established around Site 1 to a depth of 80 feet bgs, and in-situ solvent extraction of PCBs over 50 mg/kg.

B.S5B-2 Approach: Use volume estimates from previous calculations to estimate soil to be removed, and established cap design standards to estimate the required material for a cap. Calculate the linear feet required to establish a vertical barrier. Using volume estimates, calculate the amount of reagent required for in-situ solvent extraction of PCBs over 50 mg/kg. Using the depth of and the number of wells required, calculate the blower requirements for an air sparge system needed to treat residual solvent remaining in soils.

B.S5B-3 Estimate the volume of soil to be removed. See Alternative S-3 calculations (B.S3-3 - B.S3-4) for soil removal estimates, trucking estimates, and sheet piling sections.
*Note that four groundwater monitoring wells (BPS1-TT-MW301 S, I, and D, and BPS1-HN-MW27I) will be removed and replaced during the excavation.

B.S5B-4 Estimate the amount of material required for a RCRA cap.

See Alternative S-3 (B.S3-5) for RCRA cap material estimates.

B.S5B-5 Estimate the linear feet required to establish a vertical barrier around Site 1.
See Figure S4-1 for an estimated boundary (based on the area of PCBs greater than 10 mg/kg from 0 to 2 feet bgs).
See Alternative S-4 (B.S4-5) for estimated linear feet.

B.S5B-6 Calculate parameters for vertical air sparge well system.
Use the equation for adiabatic blower horsepower (this equation assumes an approximate 70% efficiency):
Blower HP = $(0.31)(V_s)[(P_d/P_a)^{0.283} - 1]$

V_s =	inlet acfm		
P_d =	discharge pressure		
P_a =	inlet pressure	=	14.7 psi

# wells	67	(Figure S5B-1)[(1)]	h=	P/γ
tdh	75	feet	γ=	62.4 lb/ft^3
height (h)	20	feet		
Q_{well}	5	cfm[(2)]		
Q_{total}	335	cfm		
minimum pressure (P)	10.4	psi		
pressure (P)	12	psi[(2)]		
power use (HP)	19	HP[(3)]		

1 = A radius of 20 feet was used to develop spacing to determine the number of wells required based on solvent injection areas.
2 = Pressure is calculated by dividing the height (in feet of water) by the specific weight of water (approximately 1 psi required per every 2.3 feet of hydraulic head). A safety factor of approximately 2 psi is applied.
3 = Horsepower (hp) is calculated by multiplying the theoretical power required to compress one cfm of air by the total cfm to produce the total horsepower required. An atmospheric pressure of 14.7 psi was used as the inlet

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B.S5B-7 Estimate the cost of electric consumption.

Power Requirement From Air Blower = P(KW) = HP*0.75 KW/HP = 14.25 KW

*1HP = 0.75 KW

Cost per kilowatt hour: 0.22 $/KWhr (U.S. Department of Labor Bureau of Labor Statistics)

*Operate 24 hours per day, for 360 days (including some equipment downtime) = 8,640 hours (hr)

KWhr = 123,120

Cost = KWhr X $/KWhr

Cost (Blower) = 27,086 $/year

B.S5B-8 Estimate the Volume of VertecBio Gold #4 Needed for Solvent Extraction

Use the full area of attainment for solvent extraction from Figure 5-5 (and Alternative 5A)

Treatment Area Thickness (ft)	Treatment Area (ft^2)	Depth of Treatment (ft)	Volume of Treatment (ft^3)	Volume of Treatment (CY)	Min Vertec Required (Residual) (gal)	Vertec for Offsite Disposal (gal)
Site 1 Deep	29,135	64	1,864,628	69,060	279,974	442,219
DW 20-08	7,081	80	566,440	20,979	85,051	107,471
Site 1 Shal.	11,686	50	584,322	21,642	87,736	177,381
DW 34-07	875	50	43,750	1,620	6,569	13,281
		Total	3,059,140	113,301	459,330	740,352
		Total Vertek			1,199,682	gallons
				Say:	**1,200,000**	**gallons**

Depth of treatment includes saturated and unsaturated, plus approxiamtely 5 to 10 feet above and below the treatment zone to disperse the solvent.

Minimum Vertec required is based on a residual concentration on soil.

Saturation concentration (from testing) = 31,170 mg/kg (Vertec Site 1 sample, first extraction cycle)

\- 814 mg/kg (Vertec Site 1 sample clean soils)

= 30,356 mg/kg = 0.03 mass fract.

Use steam or air to reduce residual to 10,119 mg/kg = 0.01 mass fract.

Specific Gravity (SG)$^{(1)}$= 0.88

Vertec for off site disposal is based on the assumed need to form a 2-foot thick free product on the water table, three times.

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B.S5B-9 Calculate the amount of PCBs removed in soils, if 50% removal occurs with each pass:

PCBs within the targeted treatment area will address the PCBs greater than 50 mg/kg and most of the PCBs within the 10 to 50 mg/kg range.

Mass of PCBs for Treatment

	Mass (lbs)	Percent Treated (greater than 10 mg/kg)	Mass Treated (lbs)	Minus mass excavated for offsite disposal (lbs)	Net Treated (lbs)
Site 1:	3,720	90%	3,348	1,100	2,248
DW 20-08	2,400	95%	2,280	0	2,280
DW 34-07	240	90%	216	0	216
	6,360		5,844	1,100	4,744

%Removal = 1 - (0.5^3) = 0.875 (three passes, 50% per pass)

Mass PCBs = 0.875 * Mass PCBs = 4,151 lbs of PCBs
Say **4,200 lbs of PCBs**

Concentration of PCBs in Vertek = 768 mg/kg

B.S5B-10 Calculate the volume of contaminated soil treated

Use the full area of attainment for solvent extraction from Figure 5-5 (and Alternative 5A)

Treatment Area Thickness (ft)	Treatment Area (ft^2)	Depth of Treatment (ft)	Volume of Treatment (ft^3)	Volume of Treatment (CY)
Site 1 Deep	29,135	49	1,427,606	52,874
DW 20-08	7,081	60	424,830	15,734
Site 1 Shal.	11,686	14	163,610	6,060
DW 34-07	875	48	42,000	1,556
		Total	2,058,046	76,224
			Say:	**76,000 CY**

Average concentration within treatment area: 18 mg/kg

B.S5B-11 Calculate the residual PCB volume and concentration of contaminated soil

Residual volume equals total minus removed minus treated.
=144,000 - 7,200 - 76,000 = **60,800 CY**

Average concentration equals mass/residual volume
=(7500-2300-3200)/56000 CY= **12 mg/kg.**

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B.S6-1 Purpose: Calculate the volume of soil to be excavated if all soils are removed above 10 mg/kg [to a depth of 65 feet below ground surface (bgs)].

B.S6-2 Approach: Use volume estimates from previous calculations (Appendix A Mass and Volume Calculations) to estimate soil to be removed.

B.S6-3 Estimate the volume of soil to be removed. Note that soils are unsaturated at a depth range of approximately 0 to 50 feet bgs (water table is located at an approximate depth of 50 feet bgs), and saturated at a depth range of approximately 50 to 65 feet bgs.

*See Figure S6-1 for estimated areas for sheet piling sections. Note that partial boxes are accounted as a portion or the nearest whole number.

B.S6-3A Volume of soil to be excavated that is saturated (Site 1) =

volume of soils in 50 - 60 feet bgs + volume of soils in 60 - 65 feet bgs (Site 1) =

A.4.11 +A.4.12

Volume = 268,150 ft^3 = 9,931 cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 15,016 tons

The required 20 foot X 20 foot sections for sheet piling (Site 1) = 6 + 5/2 = 34 sections

Half sections are added and divided by 2.

B.S6-3B Volume of soil to be excavated that is saturated (DW 20-08) =

volume of soils in 50 - 60 feet bgs =

A.6.4

Volume = 86,710 ft^3 = 3,211 cy

cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 4,856 tons

The required 20 foot X 20 foot sections for sheet piling (DW 20-08) = 5+ 4/2 = 28 sections

Half sections are added and divided by 2.

B.S6-3C Volume of soil to be excavated that is unsaturated (Site 1) =

Volume of soils in 20 - 50 feet bgs =

A.4.7 + A.4.9 + A.4.10

Volume = 382,090 ft^3 = 14,151 cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 21,397 tons

The required 20 foot X 20 foot sections for sheet piling (Site 1) = 7 + 8/2 = 44 sections

Half sections are added and divided by 2.

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B.S6-3D Volume of soil to be excavated that is unsaturated (DW 20-08) =

Volume of soils in 20 - 50 feet bgs =

A.6.1 + A.6.2 + A.6.3

Volume = 260,130 ft^3 = 9,634 cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 14,567 tons

The required 20 foot X 20 foot sections for sheet piling (DW 20-08) = 5 + 4/2 = 28 sections

B.S6-3E Volume of soil to be excavated that is unsaturated (Site 1) =

A.4.4

Volume of soils in 9 - 20 feet bgs =

Volume = 668,008 ft^3 = 24,741 cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 37,408 tons

The required 20 foot X 20 foot sections for sheet piling (Site 1) = 28 + 11/2 = 134 sections

B.S6-3F Volume of soil to be excavated that is unsaturated (Site 1) =

A.4.2

Volume of soils in 2 - 9 feet bgs =

Volume = 459,865 ft^3 = 17,032 cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 25,752 tons

Assume sheet piling is not needed for 2 - 10 feet bgs, except for the area along the road for Site 1 (eastern edge) which would require a potential 5 shoring sections to support the road.

B.S6-3G Volume of soil to be excavated that is unsaturated (Site 1) =

A.4.1

Volume of soils in 0 - 2 feet bgs =

Volume = 389,154 ft^3 = 14,413 cy

Soil Density = 112 lb/ft^3 = 3,024 lb/yd^3

Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton = 21,793 tons

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B.S6-4 Volume of Concrete Cesspools for Removal at Site 1=

Volume of concrete (cesspools,10 Diam, 16' deep) to remove= 45,216 ft^3

Concrete cesspools = 45,216 ft^3 = X 52%X150 lb/ft^3/ 2,000 lbs/ 1,763 tons

Say 1,800 tons

Assume to be hazardouus

B.S6-5 Volume of Windrow to Remove at Site 1 =

= 62,500 ft^3 = 2,315 yd^3 = 3,500 tons

B.S6-6 Volume of Gravel to Remove at Site 1 =

= 0.5 acre = 21,780 ft^3 X 95 lb/ft^3 = 1,035 tons

B.S6-7 Volume of Soil to be excavated and Disposed offsite

	Excavation Volume (cy)	Percent for Offsite Disposal	Offsite Disposal (cy)	Reused Onsite (cy)
Site 1	80,269	75%	60,202	20,067
DW20-08	12,846	90%	11,561	1,285
DW34-07	1,200	100%	1,200	0
Total	94,315		72,963	21,352
		Say	**73,000**	**21,000**

Harardous portion = same as Alternative 5A for treatment = 16,000 CY

Time required to excavate and dispose off site, assume it to be limited by trucking
Assume that 8, 15 CY trucks can be taken offsite each day.

Duration = 608 days
30 months

Residual volume equals total minus removed minus treated.
=144,000 - 73,000 = **71,000 CY**

Average concentration equals mass/residual volume
=(7500-6400/71000CY)= **5 mg/kg.**

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B.S7-1 PURPOSE: Calculate the volume of soil to be excavated if soils are removed above 1 mg/kg to a depth of 65 feet below ground surface (bgs).

B.S7-2 Approach: Use area estimates from attached figures (MVS mapping software as inputted into GIS and verified with available sampling data, Figures S7-1 to S7-7) to estimate soil to be removed.

B.S7-3 Estimate the volume of soil to be removed from Site 1. Note that soils are unsaturated to a depth of 50 feet bgs, and saturated beyond this depth (water table is located at an approximate depth of 50 feet bgs).

	Area		Volume	
Soil in 0 - 2 feet bgs (from mass/volume 4.1) =	194,577	ft^2 =	14,413	CY
Soil in 2 - 10 feet bgs (from Figure S7-1) =	132,224	ft^2 =	39,177	CY
Soil in 10 - 20 feet bgs (from Figure S7-2) =	93,171	ft^2 =	34,508	CY
Soil in 20 - 30 feet bgs (from Figure S7-3) =	56,307	ft^2 =	20,854	CY
Soil in 30 - 40 feet bgs (from Figure S7-4) =	6,192	ft^2 =	2,293	CY
Soil in 40 - 50 feet bgs (from Figure S7-5) =	13,525	ft^2 =	5,009	CY
Soil in 50 - 60 feet bgs (from Figure S7-6) =	22,470	ft^2 =	8,322	CY
Soil in 60 - 70 feet bgs (from Figure S7-7) =	22,470	ft^2 =	4,161	CY
TOTAL =	540,936	ft^2 =	128,739	CY
		SAY =	130,000	yd^3

B.S7-4 Estimate the volume of soil to be removed from DW 20-08. Note that soils are unsaturated to a depth of 50 feet bgs, and saturated beyond this depth (water table is located at an approximate depth of 50 feet bgs).

	Area		Volume	
Soil in 0 - 2 feet bgs =	0	ft^2 =	0	CY
Soil in 2 - 10 feet bgs =	0	ft^2 =	0	CY
Soil in 10 - 20 feet bgs =	0	ft^2 =	0	CY
Soil in 20 - 30 feet bgs (from Figure S7-3) =	11,006	ft^2 =	4,076	CY
Soil in 30 - 40 feet bgs (from Figure S7-4) =	9,627	ft^2 =	3,566	CY
Soil in 40 - 50 feet bgs (from Figure S7-5) =	1,396	ft^2 =	517	CY
Soil in 50 - 60 feet bgs (from Figure S7-6) =	6,291	ft^2 =	2,330	CY
Soil in 60 - 70 feet bgs =	6,291	ft^2 =	2,330	CY
TOTAL =	34,611	ft^2 =	12,819	CY
		SAY	12,800	CY

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B.S7-5 Trucking Removal Estimates (Amount to be Removed from the Site 1):

Soil Density =		112 lb/ft^3 =	3,024 lb/yd^3		
Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton =			196,560 tons		
Using 20-ton trucks for removal, would use:		9,828 trucks			
Area of gravel to remove =		SAY			
=	0.5 acre =	21,780 ft^3 X 85 lb/ft^3 =		926 tons	
=	926 tons + (27 ft^3/cesspool X 120 cesspools / 85 lb/ft^3)=			1,063 tons	
Volume of concrete (cesspools, 11' OD diameter, 10 ID, 16' deep) to remove=				45,216 ft^3	
Concrete cesspools =	45,216 ft^3 =	X 52%X150 lb/ft^3/ 2,000 lbs/		1,763 tons	
		Say		**1,800 tons**	

B.S7-6 Trucking Removal Estimates (Amount to be Removed from DW 20-08):

Soil Density =	112 lb/ft^3 =	3,024 lb/yd^3
Total Soils = ($V_{contaminated}$*soil density)/2,000 pounds/ton =		19,354 tons
Using 20-ton trucks for removal, would use:	968 trucks	

B.S7-7 Using blocks of 20 feet by 20 feet for sheet piling, estimate the number of sections for Site 1(for depths of 2 to 70 feet bgs, due to the area requiring support along Plant 3 and the fence line):
Assume that the 0 to 2 feet section of top soil would not require sheet piling.

Linear feet along fence line = 400 feet + linear feet along Plant 3 = 150 feet = 600 ft =
Soil in 2 - 10 feet bgs (from Figure S7-1) = 30 blocks
Calculate the remaining blocks by dividing the area (from Figure) by 400 square feet (20 by 20 feet blocks):

	Area	# of Blocks
Soil in 10 - 20 feet bgs (from Figure S7-2) =	93,171 ft^2 =	233 blocks
Soil in 20 - 30 feet bgs (from Figure S7-3) =	56,307 ft^2 =	141 blocks
Soil in 30 - 40 feet bgs (from Figure S7-4) =	6,192 ft^2 =	15 blocks
Soil in 40 - 50 feet bgs (from Figure S7-5) =	13,525 ft^2 =	34 blocks
Soil in 50 - 60 feet bgs (from Figure S7-6) =	22,470 ft^2 =	56 blocks
Soil in 60 - 70 feet bgs (from Figure S7-7) =	22,470 ft^2 =	56 blocks
	TOTAL =	565 blocks
	SAY =	570 blocks

B.S7-8 Using blocks of 20 feet by 20 feet for sheet piling, estimate the number of sections for DW 20-08:

	Area	# of Blocks
Soil in 20 - 30 feet bgs (from Figure S7-3) =	11,006 ft^2 =	28 blocks
Soil in 30 - 40 feet bgs (from Figure S7-4) =	9,627 ft^2 =	24 blocks
Soil in 40 - 50 feet bgs (from Figure S7-5) =	1,396 ft^2 =	3 blocks
Soil in 50 - 60 feet bgs (from Figure S7-6) =	6,291 ft^2 =	16 blocks
Soil in 60 - 70 feet bgs (from Figure S7-7) =	6,291 ft^2 =	16 blocks
	TOTAL =	87 blocks
	SAY =	90 blocks

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B.S7-9 Volume of Soil to be excavated and Disposed offsite

	Excavation Volume (cy)	Percent for Offsite Disposal	Offsite Disposal (cy)	Reused Onsite (cy)
Site 1	150,000	87%	130,000	20,000
DW20-08	25,600	50%	12,800	12,800
DW34-07	2,400	50%	1,200	1,200
Total	178,000		144,000	34,000
		Say	**144,000**	**34,000**

Hazardous portion = same as Alternative 5A for treatment = 16,000 CY

Time required to excavate and dispose off site, assume it to be limited by trucking
Assume that 8, 15 CY trucks can be taken offsite each day.

Duration = 1200 days
60 months

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SUBJECT: Appendix B Monitoring well sampling list Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

North Sites 2,3	Shallow	BPS1-TT-MW310S, BPS1-TT-MW312S, BPS1-TT-MW313S
	Intermediate	BPS1-TT-MW311I, New2I, New 3I
	Deep	BPS1-TT-MW308D

Recharge Basins	Shallow	BPS1-TT-MW314S
	Intermediate	BPS1-TT-MW314I
	Deep	BPS1-TT-MW309D

North Site 1	Shallow	BPS1-TT-MW301S
	Intermediate	BPS1-TT-MW301I
	Deep	BPS1-TT-MW301D

South Site 1	Shallow	BPS1-FW-01, BPTT-AOC22-MW11, BPS1-TT-MW304S
	Intermediate	BPS1-TT-MW-302I2, TT-MW-304I2, New1I
	Deep	BPS1-TT-MW-302D, TT-MW304D, New1D

Border Site 1	Shallow	BPS1-TT-MW-305S, BPS1-TT-MW307S
	Intermediate	BPS1-TT-MW-305I, BPS1-TT-307I
	Deep	BPS1-TT-MW-305D, BPS1-TT-307D

28 Wells total; 24 existing, 4 new
Highlighted cells indicate new wells.

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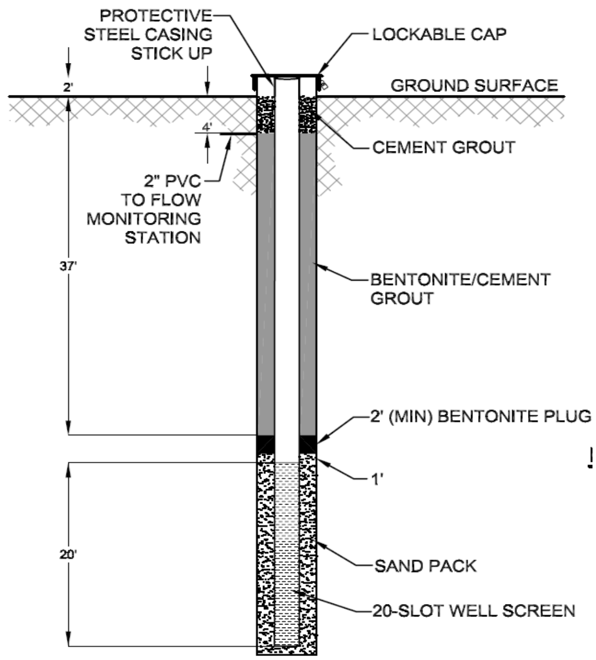
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Soil Vapor Alternative 3 (SV-3) Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015



DEEP SOIL VAPOR EXTRACTION WELL DETAIL

Note that this diagram is a depiction of how soil vapor extraction (SVE) wells were constructed for the previous soil vapor extraction containment system at Site 1. Current wells may be installed in association with soil alternatives, e.g. a cap, and therefore must account for other design requirements.

B.SV3-1 Purpose: To calculate blower requirements if soil vapor extraction wells are added to provide treatment of chlorinated volatile organic compounds in Site 1 soils.

B.SV3-2 Approach: Calculate the air delivery rate in cubic feet per minute (CFM). Use the number of wells and an assumed air extraction rate of 50 CFM per well to calculate total CFM to estimate the horsepower (HP) required of blower equipment and subsequent energy usage costs.

B.SV3-3 Estimate the extraction rate at Site 1:
Install up to six SVE wells in the source area, to be combined with the existing system capacity.
6 SVE wells (6 deep at 45 feet bgs), at 50 CFM each:

Total CFM = 300 CFM + 600 CFM (existing capacity) = 900 CFM

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B.SV3-4 Estimate the amount of pressure lost in the SVE piping system (to estimate blower sizing):

Assumed Values[1]

μ =	0.000012	lbm/feet*sec	
ε =	0.00005	ft	(Plastic/PVC pipe)
g =	32.2	ft/sec^2	
ρ_{air} =	0.077	lb/ft^3	60ºF
1 PSI (pound per square inch) =	27.7	inches of water column	

1 = Values from Table B-7 (Appendix) from Kaminski, Jensen. *Introduction to Thermals and Fluids Engineering* , 2005.

Pipe 2 Inch Diameter (ft)	Pipe Length[2] (ft)	Design Flow (CFM)	Design Velocity (ft/min)	Design Velocity (ft/sec)	Re[3] (dim)	Relative Roughness (ε/D)	Friction Factor f[4] (ft)
0.17	950	300	13,200	3.7	4,000	0.00029	0.0225

Head Loss h_f[5] (ft)	Pressure Drop (psi)	Pressure Drop (Inches WC)
27	0.0145	0.40

Therefore, say pressure drop to loss in piping is equal to = 1 inch of water column

<u>Calculations</u>

2. Pipe length includes piping from compressor building to each SVE well.

3. Re = ρ X D X V/μ

4. Using the Moody chart, a calculated relative roughness (ε/D) of 0.0003, a calculated Re = 4,000, identify the friction factor as approximately 0.0225.

5. Solve for Head Loss Using the Darcy-Weisbach Equation

$$h_f = \frac{fLv^2}{2Dg}$$

B.SV3-5 List additional losses in pressure in other components of the SVE system:

Vapor Phase Carbon Unit (Use a 5,000 pound vapor phase carbon unit - Calgon Carbon Protect VS Series)

At a flow rate of approximately 300 CFM, pressure drop equals =	2	inches of water column
Moisture Separator =	2	inches of water column
Pressure drop in piping =	1	inch of water column
SVE Wells, 3 at 35 feet bgs, at 4 inches of water column; 3 at 45 feet bgs, between 4 and 20 inches of water column* =	4 - 20	inches of water column
Maximum required is approximately =	25	inches of water column

*Measured during previous field testing of SVEC system pilot. Expect similar results (similar depths).

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SUBJECT: Soil Vapor Alternative 3 (SV-3) Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

B.SV3-6 Identify a blower rated for 300 CFM, and provides a vacuum of 25 inches of water column:
Model HP-6C, Cincinnati Fan Blower, 5 HP motor
*See Attachment

B.SV3-7 Calculate Power Requirements for 2 blowers (one main, one backup) and total electricity cost:

1 HP = 0.75 Kilowatts (KW)
Power = P(KW) = HP X 0.75 KW/HP = 3.75 KW
Cost per kilowatt hour [(6)] = 0.1723 $/KWhr
Value from http://www.eia.gov, for Long Island Power Authority, Average cost per Kilowatt-hour.
Assume operation is 360 days/year (with downtime, 24 hours per day) = 8640 hours
KWhr = 32,400
Cost = number of KWhr X Cost per KWhr =
Electrical Cost = 5,583 dollars/year
For two blowers = 11,200 dollars/year

B.SV3-8 Estimate the mass of VOCs treated by the existing SVEC system per year:

<u>PCE</u>
March 2011 average concentration (influent to SVEC system) = 400 $\mu g/m^3$
= 400 µg/m3 X lb/ 454,000 µg X 1 m3/35.31 ft3 X System Flow Rate - 400 CFM X 60 min/hr X 8,640 hours operation per year =
= 5.17 pounds

<u>TCE</u>
March 2011 average concentration (influent to SVEC system) = 420 $\mu g/m^3$
= 5.43 pounds

<u>1,1,1-TCA</u>
March 2011 average concentration (influent to SVEC system) = 135 $\mu g/m^3$
= 1.75 pounds
TOTAL POUNDS = 12.35 pounds/year

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SUBJECT: Appendix B Alternative G-3A Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

B.G3A-1 Purpose: To estimate the size of additional liquid-phase granular activated carbon (GAC) unit to treat polychlorinated biphenyls (PCBs) in groundwater.

B.G3A-2 Approach: Using the flow rate of the existing on-site containment (ONCT) system and current maximum concentration of the chrmical of concern (COC) in groundwater, estimate the size of the required units.

B.G3A-3 Estimate the size of the granular activated carbon unit:

B.G3A-3A Estimate the maximum influent PCB concentration = 8.2 μg/L(2)

2 = Value is the maximum concentration, as used for screening in the Remedial Investigation Report, for total PCBs (Aroclor-1242, -1248), and occurred in well BPS1-TT-MW304I2-01182012D.

B.G3A-3B Use the design flow rate from the existing ONCT system = 3,800 GPM

B.G3A-3C Estimate the volume of contaminated groundwater to be treated, from Mass and Volume Calculations, Section 7.4, =

1,997,280,000 gal/yr

B.G3A-3D Estimate the carbon usage rate (CUR) =

$$CUR = \frac{C_{influent(inf)}}{K(C_{inf})^{1/n}} =$$

Freundlich Parameters(3) = K = 630 $(mg/g)(L/mg)^{1/n}$

1/n = 0.73

Treatment Objective = 0.0005 mg/L (for PCBs, total)

C_{inf} = 0.0082 mg/L

$$CUR = \frac{(0.0082\ mg/L)}{630\ (mg/g)(L/mg)^{1/0.73}\ (0.0082\ mg/L)^{0.73}} = 0.000040$$

3 = Value is from "Carbon Adsorption Isotherms for Toxic Organics" by the United States Environmental Protection Agency, Municipal Environmental Research Laboratory. Cincinnati, Ohio, April 1980.

B.G3A-3E Calculate the specific through-put rate=

$$\text{Specific Through Put} = \frac{1}{\text{GAC Usage Rate}} = \frac{1}{0.0025}$$

Specific Through Put = 25,002 L H_2O treated per gram of GAC

or 3,002,945 gallons per pound of GAC

Total Estimated Volume to Treat = 1,997,280,000 gallons

B.G3A-3F Estimate the Size Unit of GAC 302,358 grams GAC = 666 pounds GAC/yr

Use a 25% efficiency factor: 2,664 pounds GAC/yr

	SAY=	**2,700**	**pounds GAC/yr**

Incremental Power Cost

Hydraulic HP = Hp*flow/1714

10 psi*3800/1714 =	22	HP
At 85% efficiency	26	HP
Power use of 26 HP =	19	Kw
Over one year:	170,450	Kw-hrs.

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
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SUBJECT: Appendix B Alternative G-3B Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

B.G3B-1 Purpose: To estimate the size of the ionic exchange resin to treat hexavalent chromium in groundwater.

B.G3B-2 Approach: Using the flow rate of the existing on-site containment (ONCT) system and current maximum concentration of the chemical of concern (COC) in groundwater, estimate the size of the required units.

B.G3B-3 Estimate the size of ion exchange resin unit:

B.G3B-3A Estimate the maximum influent hexavalent chromium concentration = 182 µg/L(1)

1 = Value is the maximum concentration, as used for screening in the Remedial Investigation Report, and occurred in well BPS1-TT-MW304I2-01182012D.

Design Flow Rate for the ONCT system = 3,800 GPM

With this flow rate, select 2 units from Calgon Carbon, Model 12 (maximum flow rate is 1,800 GPM):
Use a flow rate of: 1,700 GPM

1,700 gallons/minute X (1 minute/60 seconds) X 1 m^3/264.17 gallons = 0.107 m^3/s

B.G3B-3B List the total required resin volume (per unit):

From Model 12 spec sheet = 12 m^3 = 424 ft^3

B.G3B-3C List the backwash rate for the chosen unit (per unit): 190 GPM

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix B Alternative S-7 Mass Calculations Site 1 Bethpage, New York		CHECKED BY:	DATE: 10/5/2015

B.S7-9 CALCULATE THE MASS OF TOTAL PCBs IN CONTAMINATED SOILS AT SITE 1 (GREEN CONTOUR), over 1 PPM:

B.S7-9.1 Calculate the mass of total PCBs in 0 - 2 feet below ground surface at Site 1:
*See Appendix Figure A-1 for area locations and mean PCB concentrations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
151,952	--	2	303,904	11,256	12.36	421
195	--	2	390	14	1.3	0.06
		TOTAL:	304,294	11,270	TOTAL:	421

Example Calculation:

Mass PCBs (lbs) = 303,904 ft^3 X $\frac{112 \text{ lb soil}}{ft^3}$ X $\frac{12.36 \text{ mg PCB}}{1 \text{ X } 10^{6} \text{ mg soil}}$ 421 lbs PCBs

B.S7-9.2 Calculate the mass of total PCBs in 2 - 10 feet below ground surface at Site 1:
*See Appendix Figures S7-1 and A-2 for area locations (from GIS). Use the geometric mean to estimate the average PCB concentration in the 1 to 10 mg/kg interval = 3.2.

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
132,224	24,599	107,625	8	861,000	31,889	3.2	309
			TOTAL:	861,000	31,889	TOTAL:	309

Area >1 mg/kg = B-1; Area >10 mg/kg = B-1

B.S7-9.3 Calculate the mass of total PCBs in 10 - 20 feet below ground surface at Site 1:
*See Appendix Figures S7-2 and A-3 for area locations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
93,171	15,871	77,300	10	773,000	28,630	3.2	277
			TOTAL:	773,000	28,630	TOTAL:	277

Area > 1mg/kg = C-1 + C-2
Area > 10 mg/kg = C-1 + C-3 + C-2A +C-2B + C-2C + C-2D + C-2E + C-2F + C-3A

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B.S7-9.4 Calculate the mass of total PCBs in 20 - 30 feet below ground surface at Site 1:
*See Appendix Figures S7-3 and A-4 for area locations.

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
56,307	1,851	54,456	10	544,560	20,169	3.2	195
			TOTAL:	544,560	20,169	TOTAL:	195

Area > 1 mg/kg = D-2
Area > 10 mg/kg = D-2 + D-3 +D-4 + D-5

B.S7-9.5 Calculate the mass of total PCBs in 30 - 40 feet below ground surface at Site 1:
*See Appendix Figures S7-4 and A-5 for area locations.

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
6,192	531	5,661	10	56,610	2,097	3.2	20
			TOTAL:	56,610	2,097	TOTAL:	20

Area > 1 mg/kg = E-2
Area > 10 mg/kg = E-2

B.S7-9.6 Calculate the mass of total PCBs in 40 - 50 feet below ground surface at Site 1:
*See Appendix Figures S7-5 and A-6 for area locations.

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
13,525	431	13,094	10	130,940	4,850	3.2	47
			TOTAL:	130,940	4,850	TOTAL:	47

Area > 1 mg/kg = F-2
Area > 10 mg/kg = F-2

B.S7-9.7 Calculate the mass of total PCBs in 50 - 60 feet below ground surface at Site 1:
*See Appendix Figures S7-6 and A-7 for area locations.

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
22,470	6,017	16,453	10	164,530	6,094	3.2	59
			TOTAL:	164,530	6,094	TOTAL:	59

Area > 1 mg/kg = G-1
Area > 10 mg/kg = G-2 + G-3

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B.S7-9.8 Calculate the mass of total PCBs in 60 - 65 feet below ground surface at Site 1:
*See Appendix Figures S7-7 and A-8.

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
22,470	560	21,910	5	109,550	4,057	3.2	39
			TOTAL:	109,550	4,057	TOTAL:	39

Area > 1 mg/kg = H-1
Area > 10 mg/kg = H-1

B.S7-9.9 Calculate the total mass of PCBs at Site 1 (isocontours):
Mass PCBs, 1 to 10 mg/kg (excludes surface soil)

Total = (Mass PCBs>1 mg/kg 2-10 ft bgs) + (Mass PCBs>1 mg/kg 10-20 ft bgs) + (Mass PCBs>1 mg/kg 20-30 ft bgs) + (Mass PCBs>1 mg/kg 30-40 ft bgs) + (Mass PCBs>1 mg/kg 40-50 ft bgs) + (Mass PCBs>1 mg/kg 50-60 ft bgs) + (Mass PCBs>1 mg/kg 60-65 ft bgs) = Mass PCBs (lbs)

Mass 1 to 10 mg/kg 946 lbs SAY 950 lbs

B.S7-9.10 Calculate the mass of total PCBs in 20 - 30 feet below ground surface in DW 20-08:
*See Appendix Figure S7-3 for area locations and mean PCB concentrations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
11,006	5,956	5,050	10	50,500	1,870	3.2	18
			TOTAL:	50,500	1,870	TOTAL:	18

Area > 1 mg/kg = D-1; Area > 10 mg/kg = D-1

B.S7-9.11 Calculate the mass of total PCBs in 30 - 40 feet below ground surface in DW 20-08:
*See Appendix Figure S7-4 for area locations and mean PCB concentrations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
9,627	260	9,367	10	93,670	3,469	3.2	34
			TOTAL:	93,670	3,469	TOTAL:	34

Area > 1 mg/kg = E-1; Area > 10 mg/kg = E-1

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B.S7-9.12 Calculate the mass of total PCBs in 40 - 50 feet below ground surface in DW 20-08:
*See Appendix Figure S7-5 for area locations and mean PCB concentrations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
1,396	1,006	390	10	3,900	144	3.2	1
			TOTAL:	3,900	144	TOTAL:	1

Area > 1 mg/kg = F-1; Area > 10 mg/kg = F-1

B.S7-9.13 Calculate the mass of total PCBs in 50 - 60 feet below ground surface in DW 20-08:
*See Appendix Figure S7-6 for area locations and mean PCB concentrations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
6,291	912	5,379	10	53,790	1,992	3.2	19
			TOTAL:	53,790	1,992	TOTAL:	19

Area > 1 mg/kg = G-2; Area > 10 mg/kg = G-2

B.S7-9.14 Calculate the mass of total PCBs in 60 - 65 feet below ground surface in DW 20-08:
*See Appendix Figure S7-7 for area locations and mean PCB concentrations (from GIS).

Area of Contour >1 mg/kg [square feet (ft^2)]	Area of Contour >10 mg/kg [square feet (ft^2)]	Area (ft^2) (>1 and <10 mg/kg)	Contaminant Thickness (feet)	Volume of Contour (ft^3)	Volume of Contour (cy)	Mean Concentration in Contour mg/kg	Mass of PCBs [pounds (lbs)]
6,291	0	6,291	5	31,455	1,165	3.2	11
			TOTAL:	31,455	1,165	TOTAL:	11

Area > 1 mg/kg = H-2; Area > 10 mg/kg = N/A

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B.S7-9.14 Calculate the total mass of PCBs at DW 20-08 (isocontours):

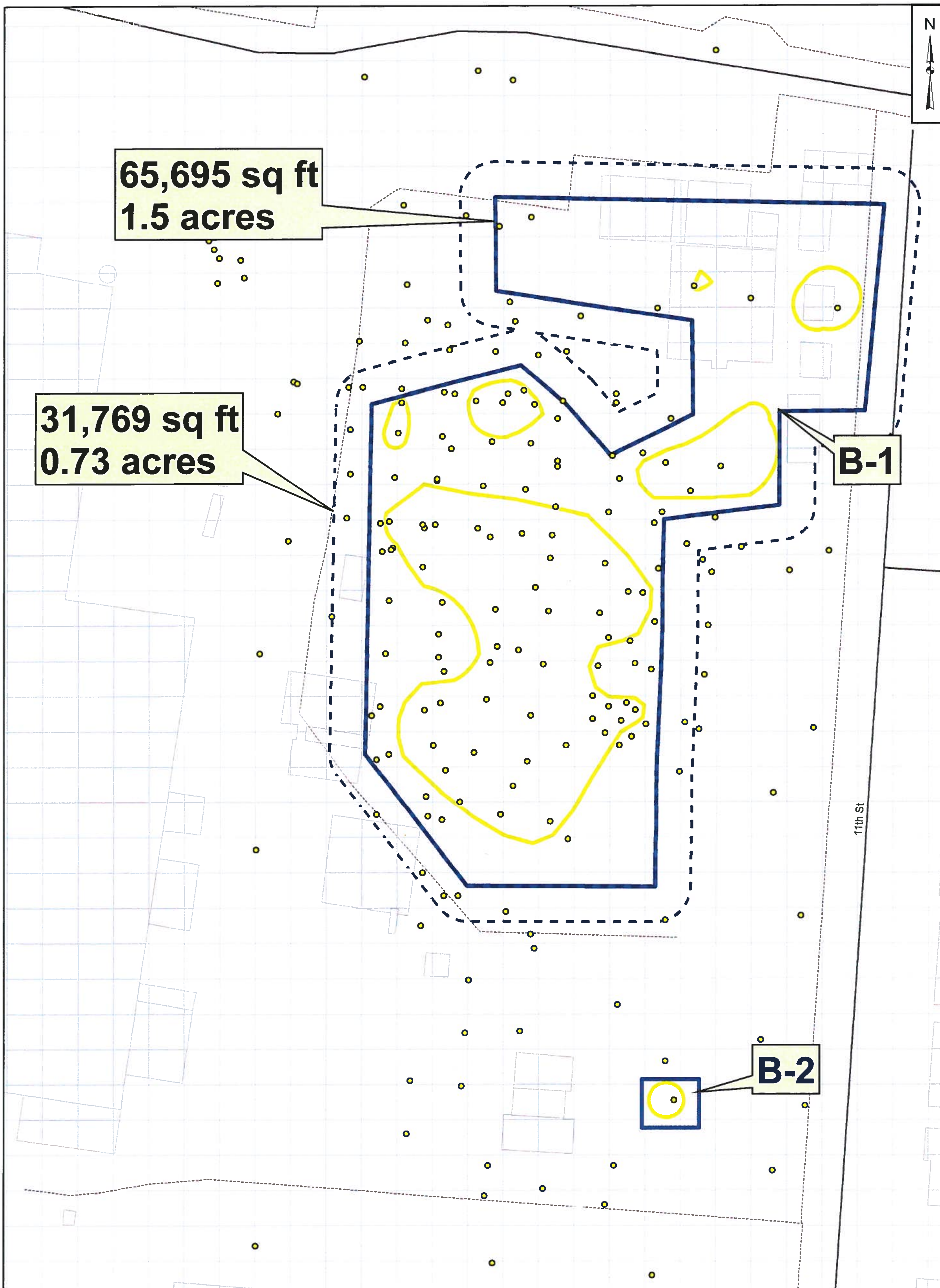
Mass PCBs, 1 to 10 mg/kg =

Total = (Mass PCBs>1 mg/kg 20-30 ft bgs) + (Mass PCBs>1 mg/kg 30-40 ft bgs) + (Mass PCBs>1 mg/kg 40-50 ft bgs) + (Mass PCBs>1 mg/kg 50-60 ft bgs) + (Mass PCBs>1 mg/kg 60-65 ft bgs)= Mass PCBs (lbs)

Mass 1 to 10 mg/kg = 84 lbs SAY 100 lbs

B.S7-9.15 Calculate the total mass of PCBs at Site 1, DW 20-08 and DW 34-07 (using 10 ppm contour for 34-07, see Appendix A):

Mass PCBs > 1 to 10 mg/kg	1,110	lbs
Mass PCBs > 10 mg/kg =	6,360	lbs
TOTAL =	7,470	lbs



Legend

- Soil Boring Location
- Excavation Area
- Excavation Buffer 20 ft
- 10 mg/kg at 2-10 feet bgs

0 50 100 Feet

Location	Area-Sq Ft	Mean PCB 10 mg/kg
B-1	65,695	38.8
B-2	900	34
Buffer	31,769	

TETRA TECH

PCB
2-10 foot
10 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE 112G02230
SCALE AS NOTED
FIGURE NO
REV
DATE 10/29/14

S2-1

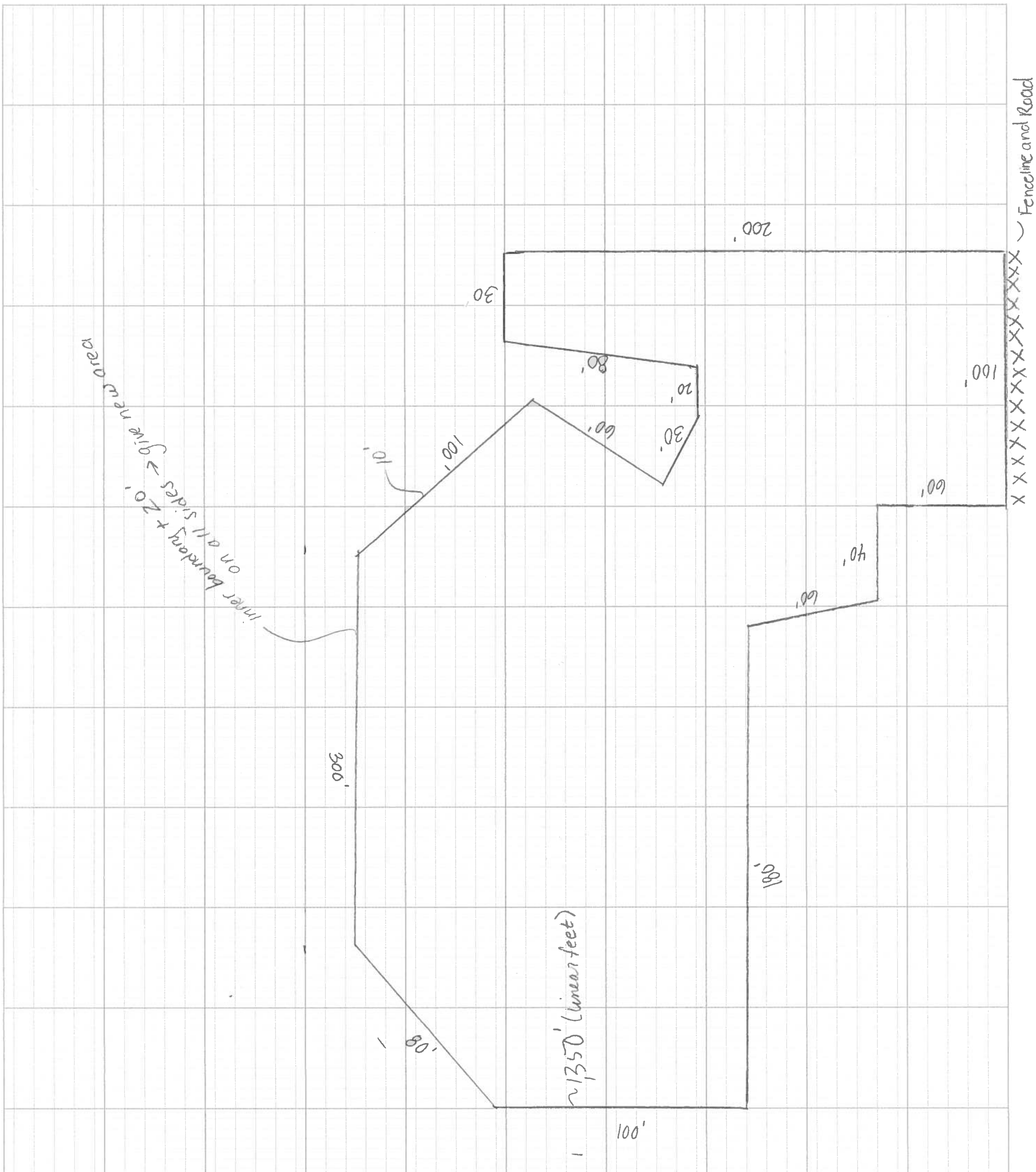


FIGURE S4-1: ESTIMATED VERTICAL BARRIER BOUNDARY, 10 mg/kg boundary (FROM FIGURE A-2)

Total Linear Feet = 1,350'

TETRA TECH

PCB
Above 50 mg/kg ISOCONCENTRATION
10-70 Feet bgs
NWIRP BETHPAGE, NEW YORK

FILE 112G02230	SCALE AS NOTED
FIGURE NO. 6 S-5B-1	REV	DATE 10/7/14

VertecBio Gold #4

Methyl Soyate

BioBased Solvent

Soybean Derived

Technical grade methyl soyate, ideal for formulating hand cleaners, mastic/adhesive removers, asphalt release agents and industrial cleaners. This VertecBio Gold is 100% methyl soyate. Flash point over 200 F, and less than 5% VOCs.

- **Ideal for Formulating Hand Cleaners, Asphalt Release Agents**
- **Low VOC**
- **Very Low Vapor Pressure**
- **100% Biodegradable**
- **Excellent Degreaser**
- **Safe, Non-Toxic, Non-Carcinogenic**
- **Flash Point over 200 ^{o}F**
- **No Environmentally Hazardous Ingredients**
- **100% Biobased content, made from Renewable Resources**
- **No ODC's---No Ozone Depleteing Chemicals**
- **No HAP's---No Hazardous Air Pollutants**
- **No Global Warming Compounds**
- **EPA Approved SNAP Solvent**
- **Non SARA 313 Reportable**
- **Non-Hazardous under RCRA**
- **No Petroleum Ingredients**

Design for the Environment

U.S. EPA

Recognized As Environmentally Preferable Chemistry

TECHNICAL DATA

Flash Point..>200 F ASTM D93 closed cup
Vapor Pressure………....<1 mmHg @ 68 F
pH of Water Dispersion……………….4.3
Specific Gravity………………………0.88
Evaporation Rate……...……………....<.1
Vapor Density…………………………..>4
Boiling Point…………...………..> 600 F
CAS No: ……...67784-80-9 or 67762-38-3

Vertec BioSolvents Inc. *1441 Branding Lane, Suite 100 Downers Grove, IL 60515 USA*
☎ *630.960.0600 • 630.960.0660 (fax) • www.vertecbiosolvents.com*

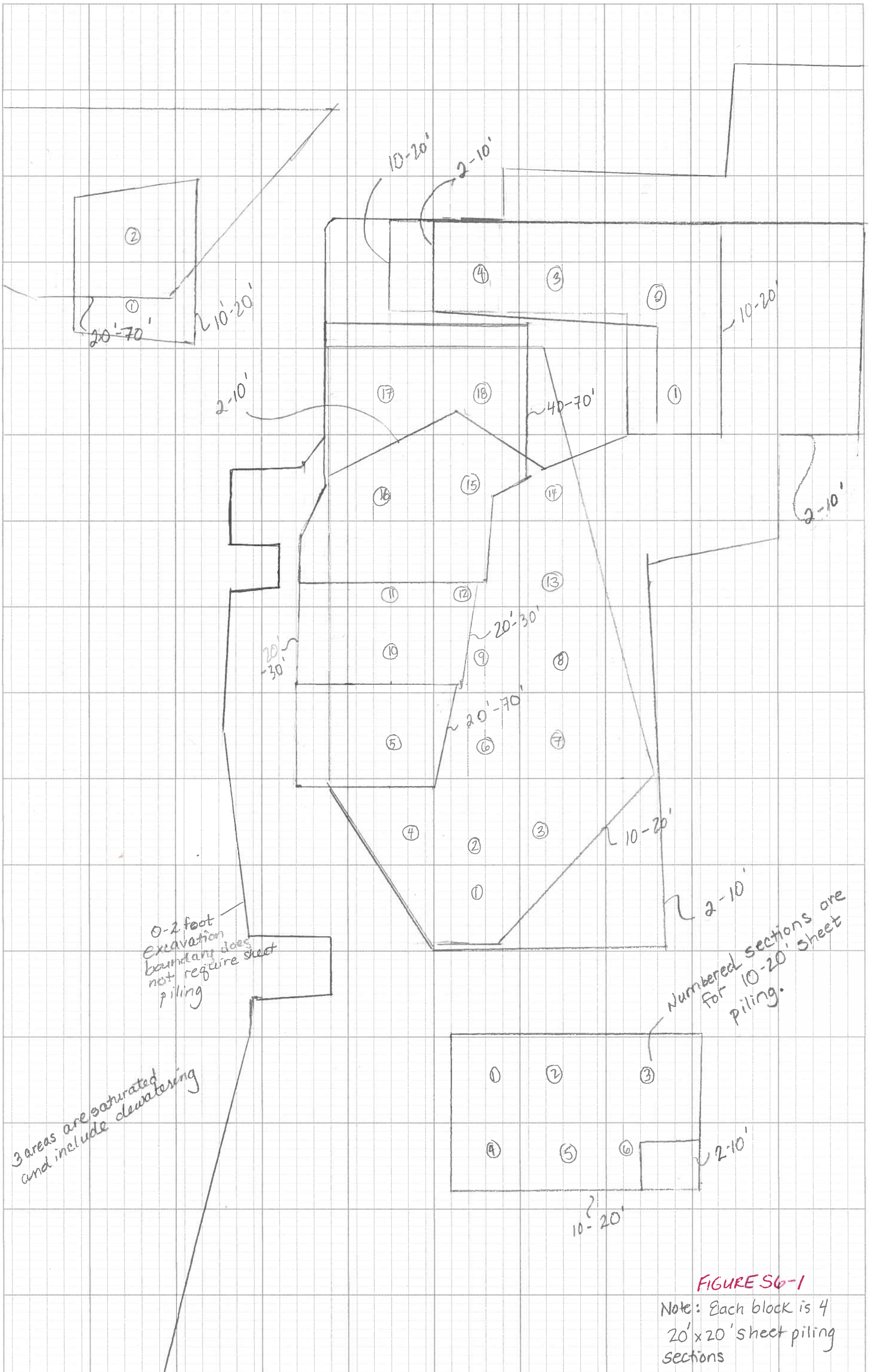


FIGURE S6-1

Alternative S-6
Excavation Sheet Piling

Legend

- Soil Boring Location
- 1 mg/kg at 2-10 feet bgs

0 50 100 Feet

Location	Area (sq feet)	Mean PCB (mg/kg)
B-1	132,224	16

TETRA TECH

PCB
2-10 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE	112G05720	SCALE	AS NOTED
FIGURE NO.	S7-1	REV	DATE 2/26/15

P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS_RA\2-10ft_1mgkg.MXD mmc

Legend

- Soil Boring Location
- 1 mg/kg @ 10-20 feet bgs

0 50 100 Feet

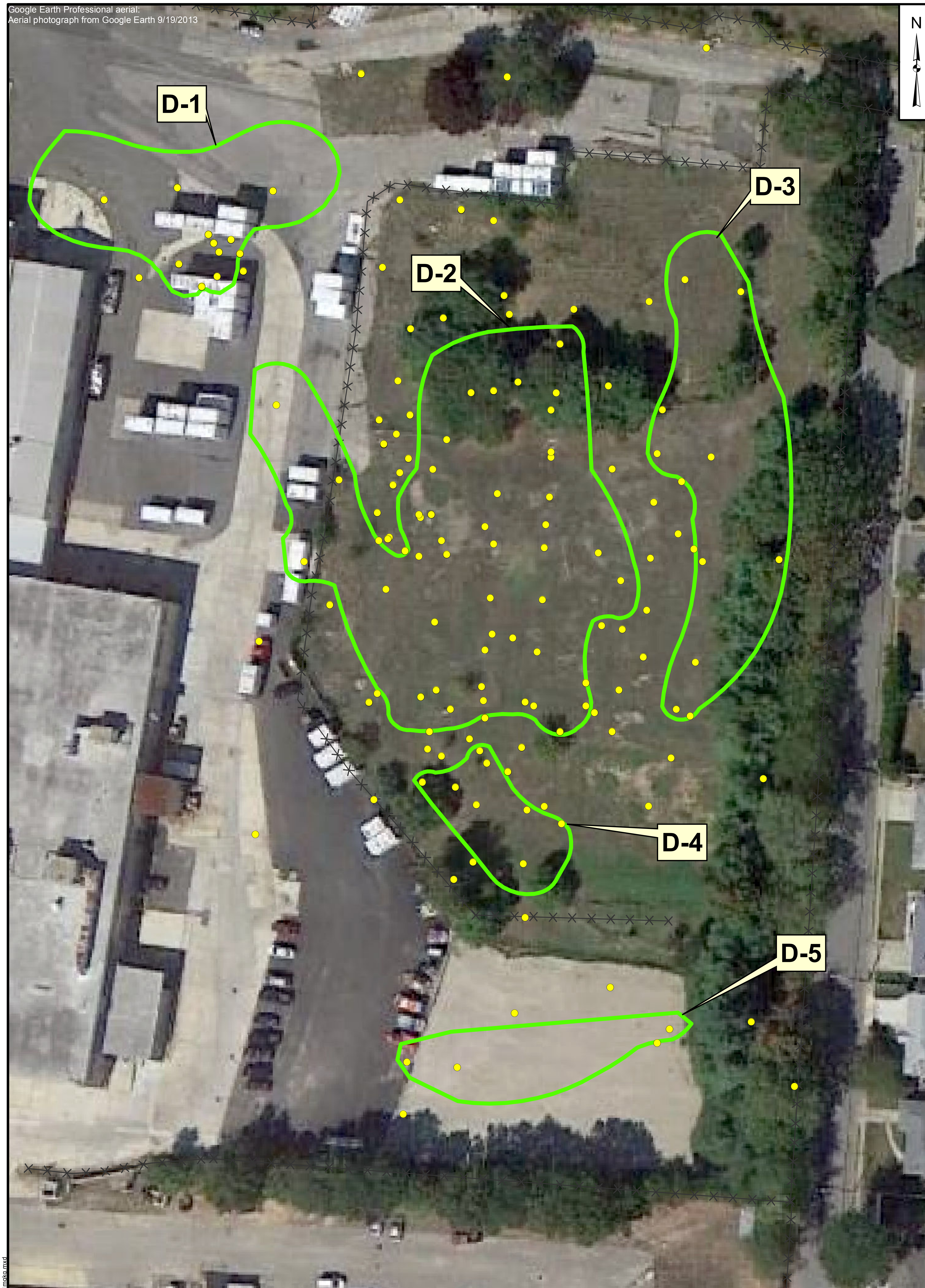
Location	Area (sq feet)	Mean PCB (mg/kg)
C-1	87,043	38
C-2	6,128	21.22

TETRA TECH

PCB
10-20 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE 112G05720	SCALE AS NOTED
FIGURE NO. **S7-2**	REV DATE 3/2/15

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS-RA\10-20ft_1mgkg.mxd



Legend

- Soil Boring Location
- 1 mg/kg @ 20-30 feet bgs

0 50 100 Feet

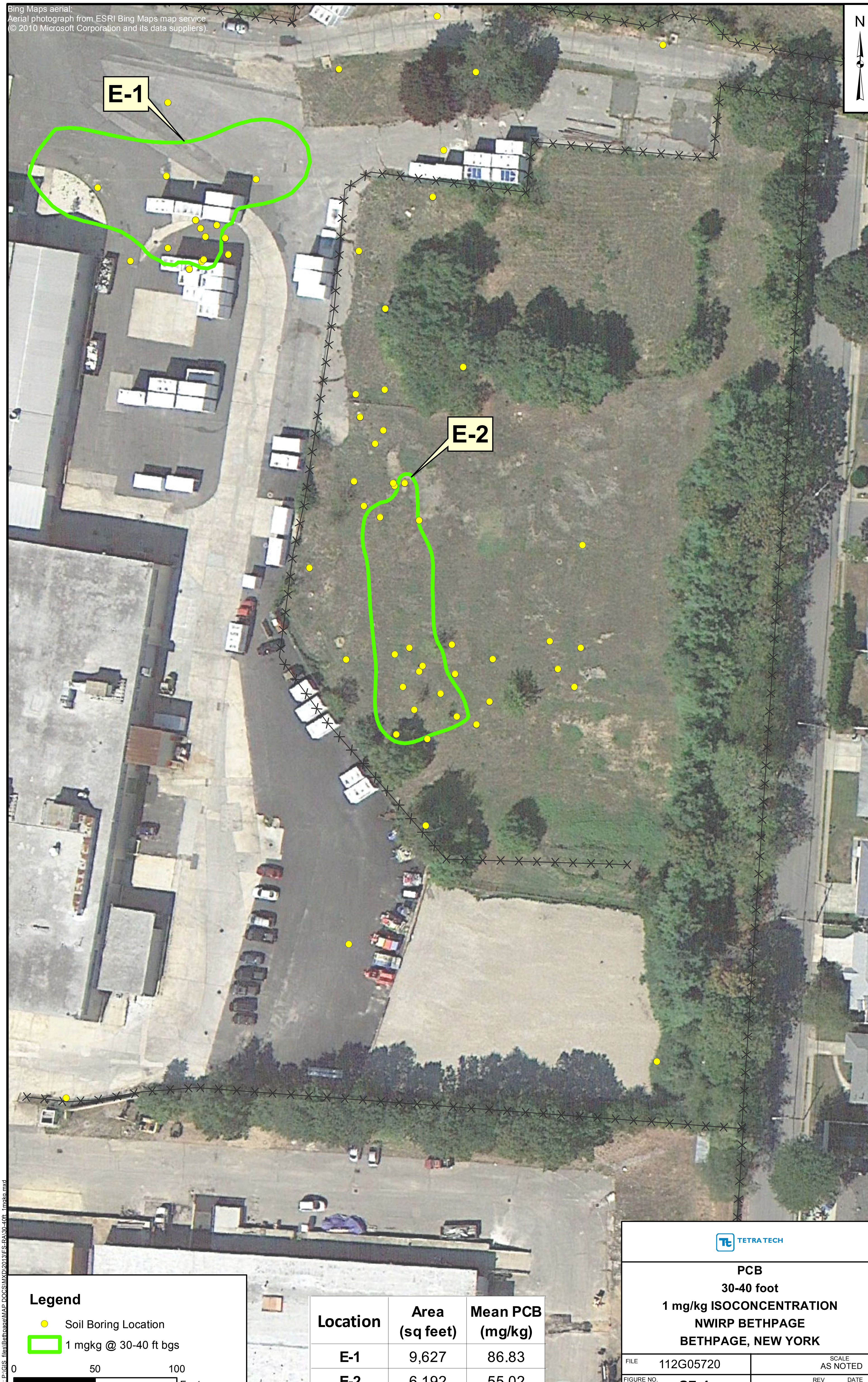
Location	Area (sq feet)	Mean PCB (mg/kg)
D-1	11,006	1,547
D-2	32,574	49.3
D-3	14,581	2.88
D-4	3,946	3.06
D-5	5,206	2.05

TETRA TECH

PCB
20-30 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE, NEW YORK

FILE	112G05720	SCALE	AS NOTED
FIGURE NO.	S7-3	REV	DATE 3/3/15

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS-RA\20-30ft_1mgkg.mxd



Legend

- Soil Boring Location
- 1 mgkg @ 30-40 ft bgs

0 50 100 Feet

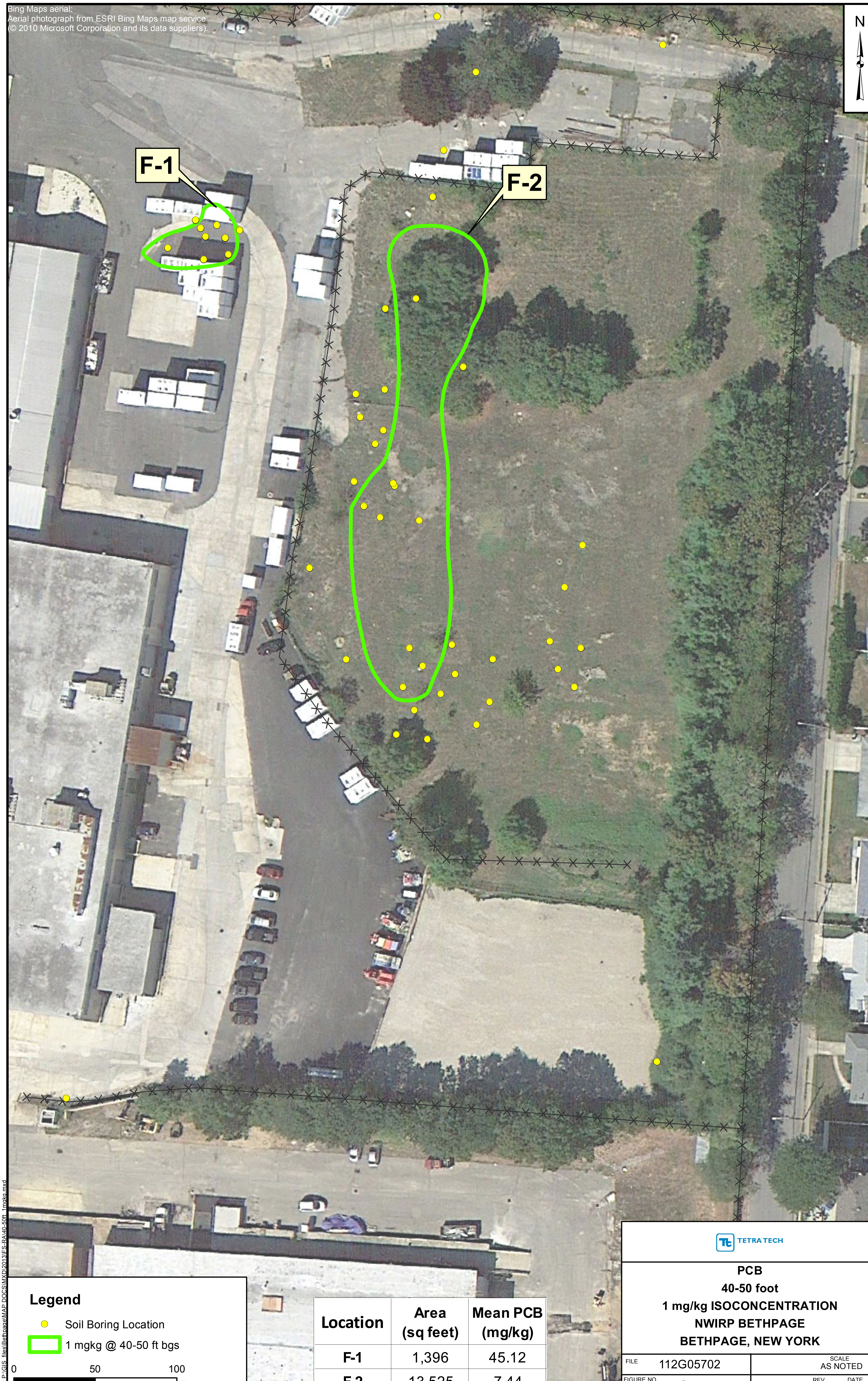
Location	Area (sq feet)	Mean PCB (mg/kg)
E-1	9,627	86.83
E-2	6,192	55.02

TETRA TECH

PCB
30-40 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE	112G05720	SCALE	AS NOTED
FIGURE NO.	S7-4	REV / DATE	3/2/15

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS-RA\30-40ft_1mgkg.mxd



Location	Area (sq feet)	Mean PCB (mg/kg)
F-1	1,396	45.12
F-2	13,525	7.44

TETRA TECH

PCB
40-50 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	S7-5	REV / DATE	3/2/15

Location	Area (sq feet)	Mean PCB (mg/kg)
G-1	22,470	77
G-2	6,291	94.06

TETRA TECH

PCB
50-60 foot
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE	112G05702	SCALE	AS NOTED
FIGURE NO.	S7-6	REV	DATE 3/2/15

Legend

- Soil Boring Location
- 1 mgkg @ 60-65 ft bgs

0 50 100 Feet

Location	Area (sq feet)	Mean PCB (mg/kg)
H-1	22,470	34
H-2	6,291	3

TETRA TECH

PCB
60-65 feet
1 mg/kg ISOCONCENTRATION
NWIRP BETHPAGE
BETHPAGE, NEW YORK

FILE 112G05702 SCALE AS NOTED

FIGURE NO. S7-7 REV DATE 3/19/15

Path: P:\GIS_files\Bethpage\MAP DOCS\MXD\2013\FS-RA\60-70ft_1mgkg.mxd

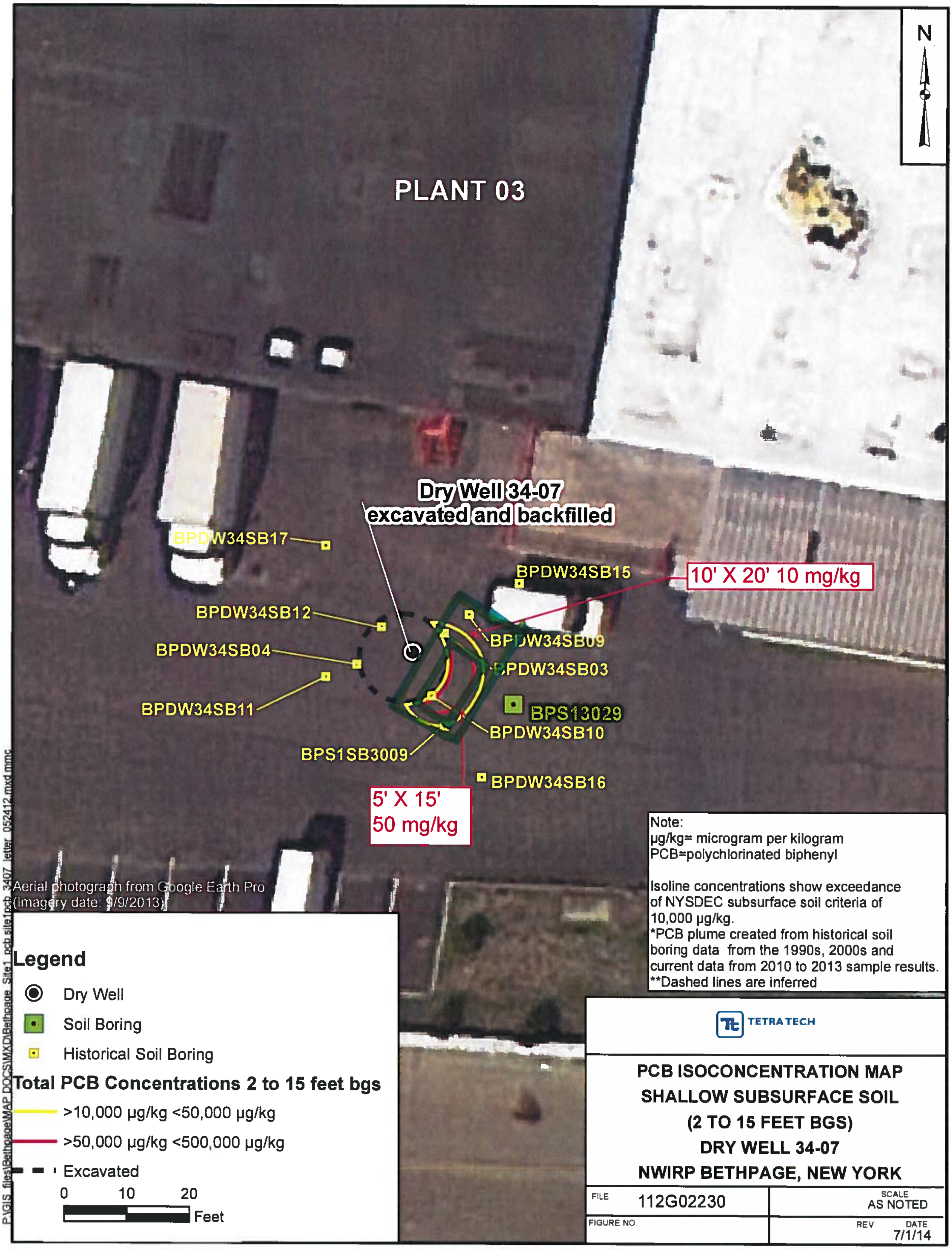
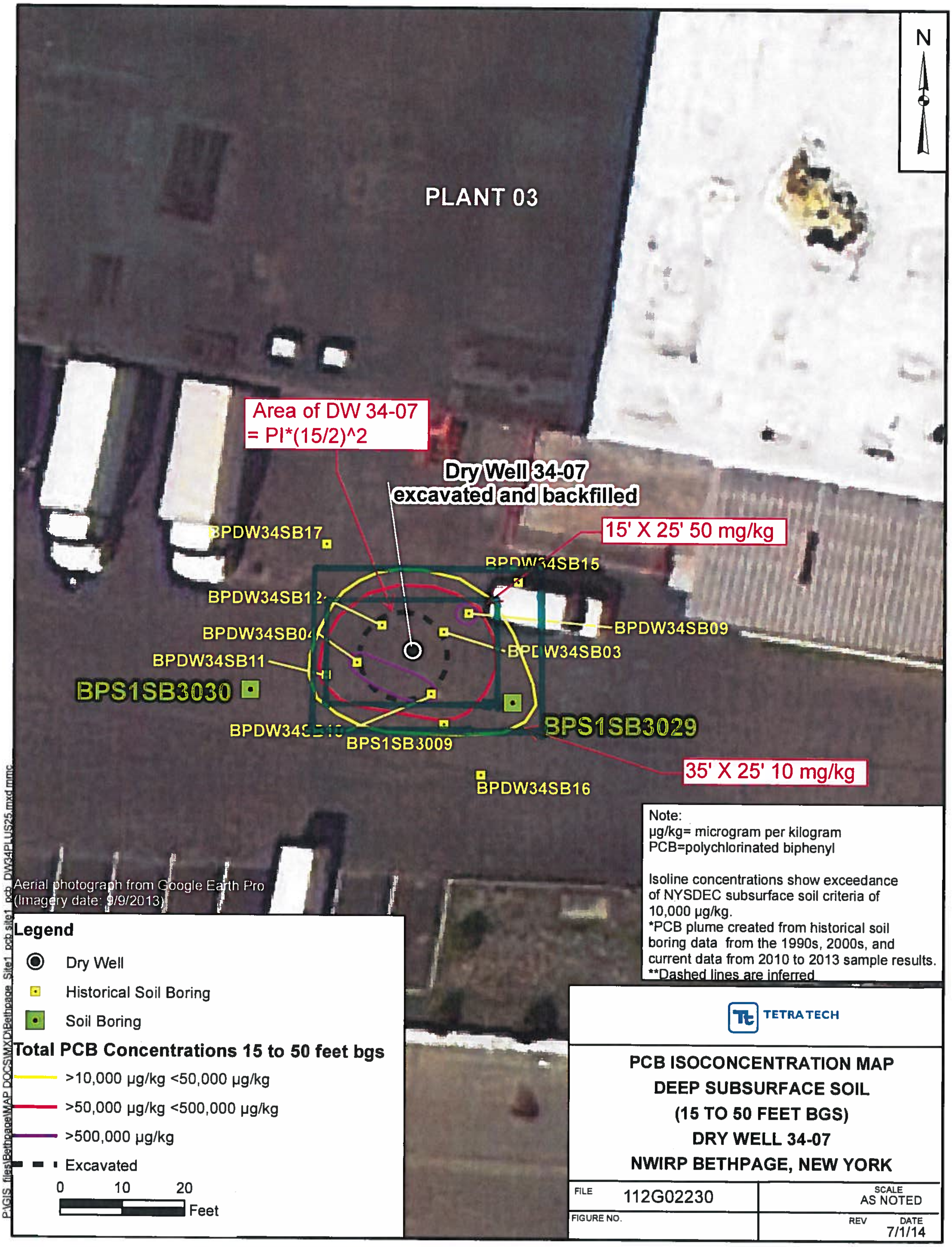

N
PLANT 03
Dry Well 34-07
excavated and backfilled
BPDW34SB17
BPDW34SB15
10' X 20' 10 mg/kg
BPDW34SB12
BPDW34SB09
BPDW34SB04
BPDW34SB03
BPDW34SB11
BPS13029
BPDW34SB10
BPS1SB3009
BPDW34SB16
5' X 15'
50 mg/kg
Aerial photograph from Google Earth Pro
(Imagery date: 9/9/2013)
Note:
µg/kg= microgram per kilogram
PCB=polychlorinated biphenyl
Isoline concentrations show exceedance of NYSDEC subsurface soil criteria of 10,000 µg/kg.
*PCB plume created from historical soil boring data from the 1990s, 2000s and current data from 2010 to 2013 sample results.
**Dashed lines are inferred
Legend
Dry Well
Soil Boring
Historical Soil Boring
Total PCB Concentrations 2 to 15 feet bgs
>10,000 µg/kg <50,000 µg/kg
>50,000 µg/kg <500,000 µg/kg
Excavated
0
10
20
Feet
TETRA TECH
PCB ISOCONCENTRATION MAP
SHALLOW SUBSURFACE SOIL
(2 TO 15 FEET BGS)
DRY WELL 34-07
NWIRP BETHPAGE, NEW YORK
FILE
112G02230
SCALE
AS NOTED
FIGURE NO.
REV
DATE
7/1/14

Figure A-9



N
PLANT 03
Area of DW 34-07
= PI*(15/2)^2
Dry Well 34-07
excavated and backfilled
15' X 25' 50 mg/kg
BPDW34SB17
BPDW34SB15
BPDW34SB09
BPDW34SB03
BPDW34SB11
BPS1SB3030
BPS1SB3029
BPS1SB3009
BPDW34SB16
35' X 25' 10 mg/kg
Aerial photograph from Google Earth Pro
(Imagery date: 9/9/2013)
Note:
µg/kg= microgram per kilogram
PCB=polychlorinated biphenyl
Isoline concentrations show exceedance of NYSDEC subsurface soil criteria of 10,000 µg/kg.
*PCB plume created from historical soil boring data from the 1990s, 2000s, and current data from 2010 to 2013 sample results.
**Dashed lines are inferred
Legend
Dry Well
Historical Soil Boring
Soil Boring
Total PCB Concentrations 15 to 50 feet bgs
>10,000 µg/kg <50,000 µg/kg
>50,000 µg/kg <500,000 µg/kg
>500,000 µg/kg
Excavated
0 10 20
Feet
TETRA TECH
PCB ISOCONCENTRATION MAP
DEEP SUBSURFACE SOIL
(15 TO 50 FEET BGS)
DRY WELL 34-07
NWIRP BETHPAGE, NEW YORK
FILE 112G02230
SCALE AS NOTED
FIGURE NO.
REV
DATE 7/1/14
P:\GIS_files\Bethpage\MAP DOCS\MXD\Bethpage_Site1_pcb_site1_pcb_DW34PLUS25.mxd.mmc

Figure A-10

Note:
µg/kg= microgram per kilogram
PCB=polychlorinated biphenyl

Isoline concentrations show exceedance of NYSDEC subsurface soil criteria of 10,000 µg/kg.
*PCB plume created from historical soil boring data from the 1990s, 2000s, and current data from 2010 to 2013 sample results.
**Dashed lines are inferred

Legend

- Dry Well
- Historical Soil Boring
- Soil Boring

Total PCB Concentrations 15 to 50 feet bgs

- >10,000 µg/kg <50,000 µg/kg
- Excavated

0 10 20 Feet

TETRA TECH

PCB ISOCONCENTRATION MAP
DEEP SUBSURFACE SOIL
50 to 54 FEET BGS)
DRY WELL 34-07
NWIRP BETHPAGE, NEW YORK

FILE 112G02230	SCALE AS NOTED
FIGURE NO.	REV DATE 10/15/14

P:\GIS_files\Bethpage\MAP DOCS\MXD\Bethpage_Site1_pcb_site1_pcb_DW34PLUS50.mxd mmc

Figure A-11

1" = 40'

* PCE, TCE still of concern for influent to SVEC System.

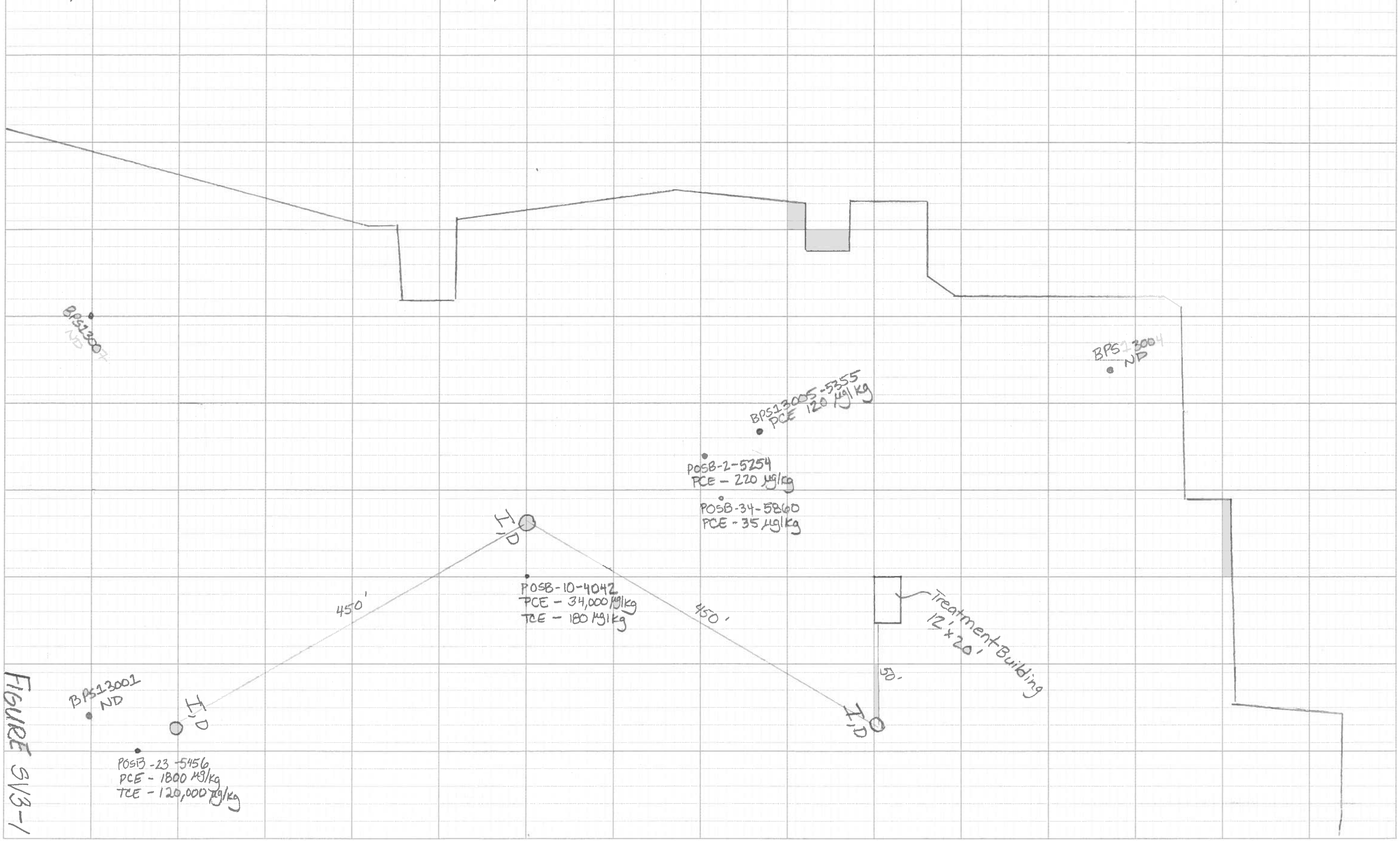


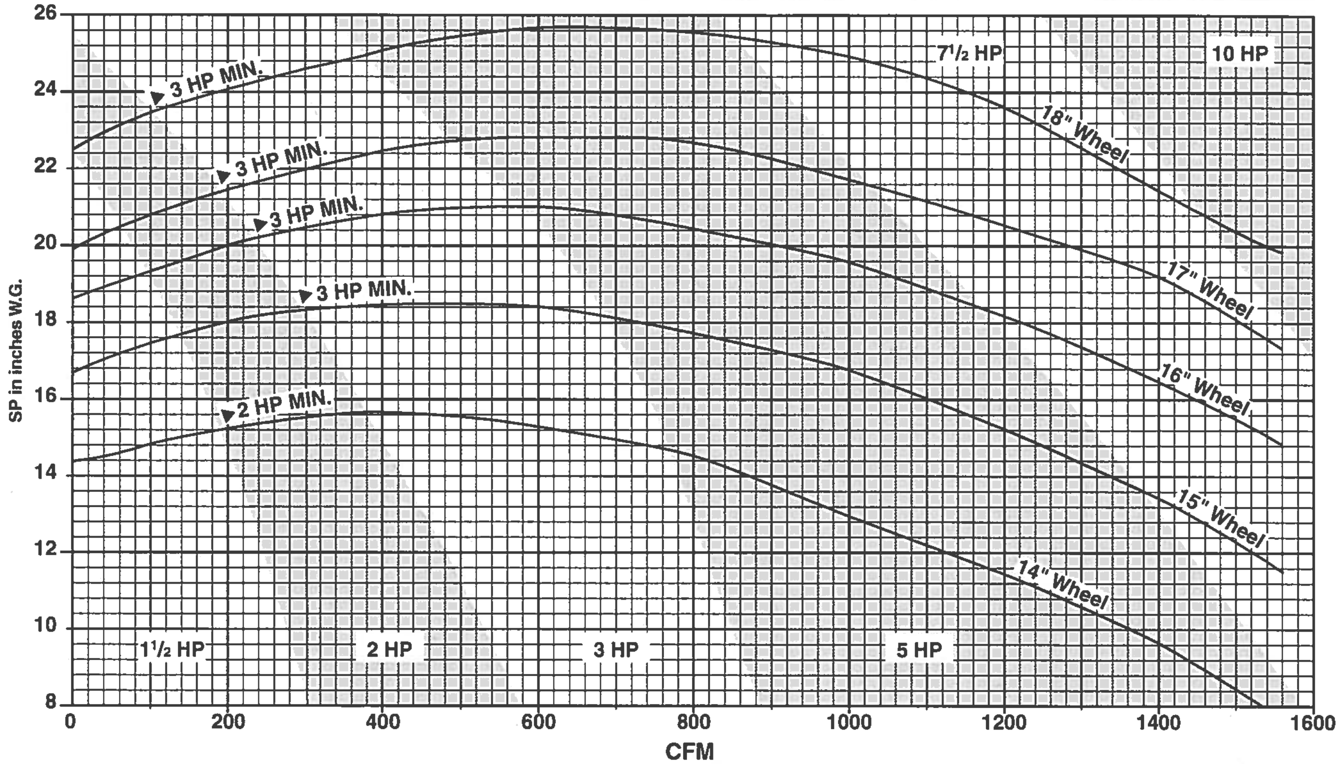
FIGURE SV3-1

DIRECT DRIVE RATINGS @ 3500 RPM

CFM and BHP at Static Pressure Shown • Ratings at 70°F., .075 Density, Sea Level

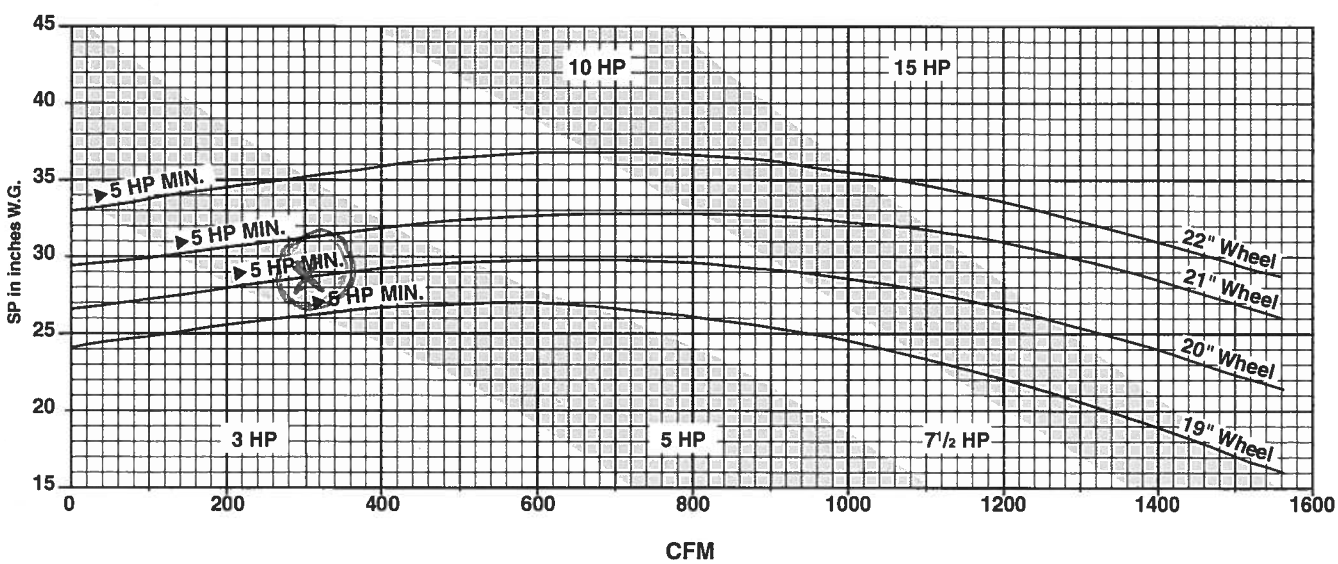
Model HP-6B

BHP values are shown. Note "▶" is minimum HP motor needed for required starting torque (WR²) for steel wheels. See page 14.



Model HP-6C

BHP values are shown. Note "▶" is minimum HP motor needed for required starting torque (WR²) for steel wheels. See page 14.



DESIGN SPECIFICATIONS

HP STEEL WHEEL WR² VALUES AND MINIMUM MOTOR HORSEPOWER

Model	WR²(lb.-FT.²)	Min. HP*
HP-4A14	3.4	1 1/2
HP-4A15	4.4	1 1/2
HP-4A16	5.7	1 1/2
HP-4A17	7.2	3
HP-4A18	9.0	3
HP-4C17	7.2	3
HP-4C18	9.0	3
HP-4C19	11.0	5
HP-4C20	13.5	5
HP-4C21	16.2	5
HP-4C22	19.4	5
HP-6B14	3.5	2
HP-6B15	4.6	3
HP-6B16	6.0	3
HP-6B17	7.6	3
HP-6B18	9.6	3
HP-6C19	11.0	5
HP-6C20	13.5	5
HP-6C21	16.2	5
HP-6C22	19.4	5
HP-6E21	19.1	5
HP-6E22	22.2	7 1/2
HP-6E23	23.8	7 1/2
HP-6E24	28.1	10
HP-6E25	32.9	10
HP-6E26	38.3	10
HP-8B15	4.6	3
HP-8B16	6.0	3
HP-8B17	7.6	5
HP-8B18	9.6	5

Model	WR²(lb.-FT.²)	Min. HP*
HP-8D17	7.6	5
HP-8D18	9.6	5
HP-8D19	11.9	5
HP-8D20	14.5	5
HP-8D21	17.6	5
HP-8D22	21.0	7 1/2
HP-8E23	23.8	7 1/2
HP-8E24	28.0	10
HP-8E25	32.9	10
HP-8E26	38.3	10
HP-10D19	11.9	5
HP-10D20	14.5	5
HP-10D21	17.6	5
HP-10D22	21.1	7 1/2
HP-10F23	26.7	7 1/2
HP-10F24	31.5	10
HP-10F25	36.8	10
HP-10F26	42.7	15
HP-12F21	19.0	5
HP-12F22	23.0	7 1/2
HP-12F23	26.7	7 1/2
HP-12F24	31.5	10
HP-12F25	36.8	10
HP-12F26	42.7	15
HP-12G26	72.0	20
HP-12G27	83.0	20
HP-12G28	95.0	20
HP-12G29	108.0	25
HP-12G30	123.0	50
HP-12G31	138.0	50

***Min. HP:** This is the suggested minimum motor horsepower for Arrangement 4 fans with a nominal 3500 RPM motor speed. In a few situations motors suitable for the fan *operating point* BHP may not have sufficient torque to start the fan as *quickly* as desired. Therefore, use a motor horsepower at least as large as those listed in the tables to the left. The suggested motor horsepower values are based on typical Baldor three phase motors. Motor starting torques from other vendors will vary. These tables do not apply to Arrangement 4 fans with 1750 RPM and 2850 RPM motors, and any belt driven fans. A smaller horsepower motor may be acceptable for some of these applications.

DIMENSIONS and SPECIFICATIONS

NOTE: The table below contains blower housing dimensions common to all arrangements on pages 15, 17 and 18.

DIMENSIONS IN INCHES ± 1/8"

DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE.

MODEL*	D	M	O	P	R	S	AA	DD①
HP-4A	4	11 3/4	18	13 9/16	14 3/8	12 3/4	6	4
HP-4C	4	14 13/16	17 7/8	16 7/16	17 7/16	15 7/16	6	4
HP-6B	6 3/8	11 3/4	18	13 9/16	14 3/8	12 3/4	8	6
HP-6C	4	14 13/16	17 7/8	16 7/16	17 7/16	15 7/16	6	6
HP-6E	5 3/8	17 7/16	19 1/8	19 3/8	20 9/16	18 3/16	8	6
HP-8B	6 3/8	11 3/4	19 13/16	13 9/16	14 3/8	12 3/4	8	8
HP-8D	6 3/8	14 13/16	19 3/4	16 7/16	17 7/16	15 7/16	8	8
HP-8E	5 3/8	17 7/16	21	19 3/8	20 9/16	18 3/16	8	8
HP-10D	6 3/8	14 13/16	21 3/4	16 7/16	17 7/16	15 7/16	8	10
HP-10F	7 3/8	17 7/16	23	19 3/8	20 9/16	18 3/16	10	10
HP-12F	7 3/8	17 7/16	23	19 3/8	20 9/16	18 3/16	10	12
HP-12G	9	20 3/4	24 15/16	23 1/16	24 7/16	21 5/8	14	12

*COMPLETE MODEL NUMBER INCLUDES WHEEL DIAMETER.

① Discharge flange not available with downblast discharge on models HP-8B, HP-10D, HP-12F and HP-12G.

PROTECT VS
Carbon Adsorber Canisters

CalgonCarbon™

Description

The PROTECT VS vapor phase carbon adsorber canisters are air or vapor treatment units that can treat higher flow rates or contain larger beds of activated carbon, but with the convenience of an economical canister. PROTECT VS canisters contain all of the operating elements required for utilization of granular activated carbon in air or vapor treatment, including a flat carbon bed support across the entire bed cross sectional area and plenum area below this support for effective air introduction and distribution across the bed. The canisters are constructed of unlined carbon steel with a stainless steel screen bed support for use with activated carbon in air treatment.

The PROTECT VS vapor phase carbon adsorber canisters are available in 3 sizes that can contain up to 8,000 pounds of granular activated carbon for treating air or vapor sources typically up to 4,500 cfm. The PROTECT VS canisters can be used in operating pressures up to 1 psi and a moderate vacuum of up to 5 inches Mercury.

The PROTECT VS vapor phase adsorbers can be provided with any of Calgon Carbon's wide variety of vapor phase activated carbon products that can be selected for a specific air or vapor treatment application. Most commonly used are Type AP4-60 grade virgin activated carbon, which is a 4mm pelletized activated carbon with a Carbon Tetrachloride Number of 60 for higher purity air or vapor, or optimal usage for low levels of organic contamination, or Type VPR quality controlled reactivated grade vapor phase carbon for a more economical carbon product for general air treatment.

Features

The PROTECT VS vapor phase carbon adsorber canisters offer several important features that make it an effective value driven option for many air or vapor phase treatment applications:• Sturdy carbon steel construction

- Sturdy carbon steel construction
- Capable of operating up to 1 psig which will manage most vent or exhaust fan situations.
- Exterior painted with a durable urethane finish
- Operating temperature up to 200 degrees F
- Top 16 inch diameter access port for activated carbon media fill and removal
- Carbon bed support across the full canister cross sectional area, consisting of 20 mesh type 316 stainless steel screen placed on steel grating for vapor distribution across the entire bed for maximum activated carbon utilization and low pressure drop.
- Top lifting lugs and bottom fork guides for portability

Specifications

Canister	Sturdy carbon steel canister with ¼" thick steel shell and ¼" steel flat bottom and top heads (⅜" thickness for Model VS-8)
Pressure	Recommended 1 psig maximum operating pressure (shop hydrotested in excess of recommended pressure)
Vacuum	Recommended maximum 5" Hg vacuum operation
Temperature	Recommended 200°F (max)
Internal Coating	None – unfinished steel
External Coating	Direct-to-Metal polyurethane
Inlet (bottom side)	6"-12" RF weld neck 150# flange (refer to chart for sizes for each Model)
Inlet Distributor	Stainless steel screen bed support on galvanized steel grating
Outlet (top side)	6"-12" RF weld neck 150# flange (refer to chart for sizes for each Model)
Drain (2 on bottom)	¾" FPT coupling with ¾" threaded plug
Access Port	16" diameter access port with threaded clamp ring and BUNA-N gasket.
Dimensions	Refer to Model Chart

Installation

PROTECT VS canisters are shipped ready for installation with the dry activated carbon fill installed in the unit. The canisters are self supporting and should be set on a level accessible area as near as possible to the emission source. Standard installation does not utilize any anchoring devices. Installation is simple requiring a flexible hose, duct or pipe to connect the vent or emission source to the flanged bottom inlet of the canister.

The PROTECT VS canister's treated air discharge is a flanged connection on the upper side of the vessel and can be left open or equipped with flexible hose, duct or pipe to direct the treated air to a desired discharge point. If the canister is located outside and to be vented directly, then a U-shaped outlet pipe or rain hat (such as a pipe tee) is recommended to be installed to prevent precipitation from entering the unit.

The recommended air flow for the PROTECT VS canisters are listed in the table. If higher flows are anticipated, then either a larger canister should be utilized or two or more PROTECT VS canisters should be placed in parallel operation.

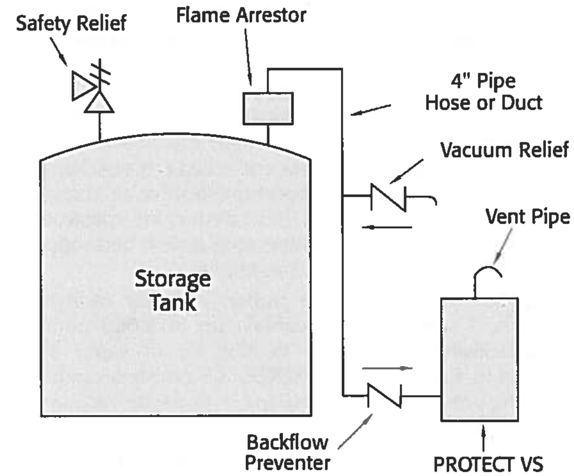
The recommended maximum static pressure and vacuum capabilities are also listed. These ratings should not be exceeded, as the canister could be irreparably damaged.

PROTECT VS canisters can be used to treat vents directly from storage tank or other process vessels. The motive force for the air or vapor can be produced by either a blower or by using the positive pressure inside the tank or process vessel. In many cases, the pressure or surge of pressure within the tank or vessel is sufficient to overcome the pressure drop across the canister, thus eliminating the need for a blower. Please consult the pressure drop data in this bulletin for more information.

When PROTECT VS canisters are used to control vapors from organic solvent storage tanks, refer to the typical installation drawing in the bulletin and the following recommended precautions:

- A safety relief valve must be provided on the storage tank. This protects the storage tank should the canister become plugged or blocked in any fashion. Such a vent would open in an emergency situation, thereby relieving pressure within the storage tank.
- Under appropriate conditions, a flame arrestor and/or backflow preventer must be installed as shown in the typical installation drawing. This prevents backflow of air through the canister when the storage tank is being emptied.
- High organic compound concentration in the vented air or vapor – defined as being greater than 0.5 to 1.0 volume % - may cause an elevated heat of adsorption in the carbon bed. This effect can be dissipated by pre-wetting the carbon to provide a heat sink, adding dilution air to the vented air or vapor to reduce the concentration, or by adding water spray to the vented air or vapor to provide an ongoing heat sink.

Typical Protect VS Installation at Storage Tank



If PROTECT VS canisters are used to control organic compound emissions from air-strippers, soil venting or other high moisture content air or vapor streams, then it is recommended that the humidity in the air stream be reduced to under 50%. High humidity may cause water vapor to condense within the carbon pores, filling the pores with water and preventing the air or vapor with organic contamination from accessing the internal surface of the activated carbon where adsorption takes place. Therefore, lower humidity will optimize the adsorptive capacity of the activated carbon. Also, for applications that may carry condensed water, it is recommended to install a drain or condensate trap on the inlet duct or piping.

Carbon Exchange or Replacement

When the treated air or vapor exceeds the desired contaminant concentration, the granular activated carbon in the PROTECT VS canister should be replaced with fresh activated carbon. The canister is to be isolated from the process by either closing and locking the inlet and outlet valves, or physically disconnecting the canister from the inlet and outlet pipe or hose. The carbon exchange procedure can either take place where the canister is installed, or the disconnected canister can be moved to another location for this activity.

The spent granular activated carbon can be removed by using a vacuum media removal procedure through the top access port. Fresh granular activated carbon can be filled using bags or "supersacks" by loading into the canister through the top access port. Refer to the table for the recommended amount of carbon to be used. Once the fresh carbon is installed and the bed leveled, the access port securely closed, and the inlet and outlet connections are reestablished, follow the procedures under the Installation section.

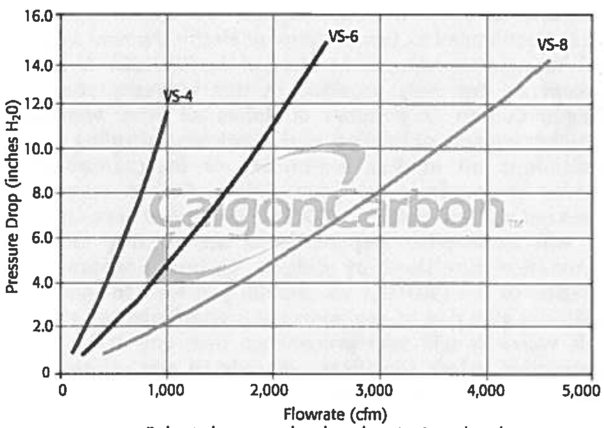
Contact Calgon Carbon Corporation for resupply of the carbon products for effective air or vapor treatment. Calgon Carbon Corporation can also provide complete turnkey services, including removal and management of the spent carbon and refilling the canister with the fresh carbon.

PROTECT VS
Carbon Adsorber Canisters

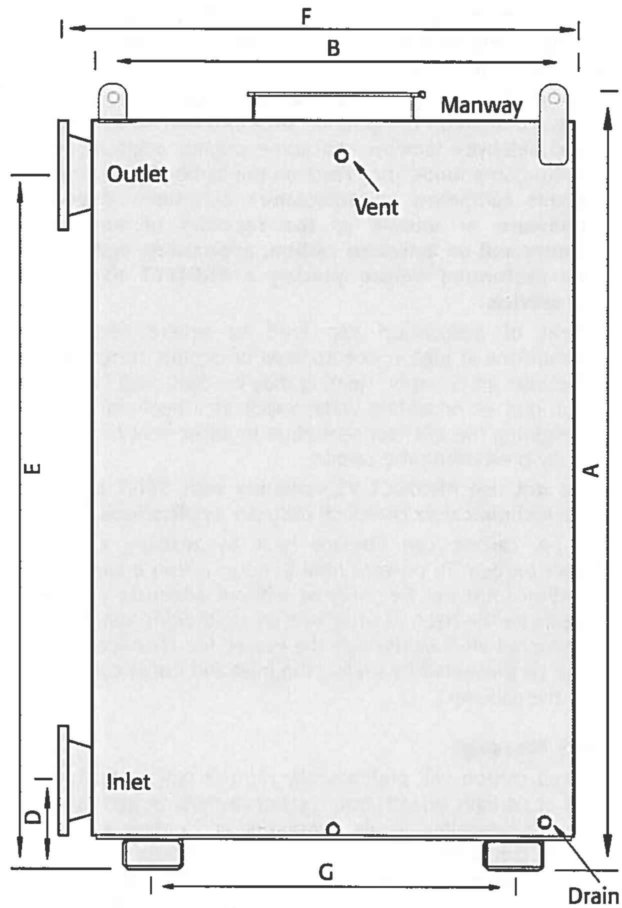
Pressure Drop Curve

Pressure drop through a PROTECT VS canister is a function of the process air flow as shown in the graph. If higher flows or lower pressure drop is needed, multiple canisters can be installed in parallel operation. The maximum pressure in the canister should not exceed 1 psig, regardless of the pressure drop across the unit.

Pressure Drop Curve



Estimated pressure drop based on 4x10 mesh carbon



Calgon Carbon Air Purification Systems

The PROTECT VS canister is designed for a variety of air or vapor applications at air flows up to 4,500 cfm and pressures up to 1 psi. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for a range of air or vapor flow rates and pressures to meet specific applications. Contact Calgon Carbon for resupply of the carbon products for effective water treatment. Calgon Carbon can also provide complete turnkey services, including removal and management of the spent carbon and refilling the unit with the fresh carbon.

Model Information

Model Number	VS 4	VS 6	VS 8
GAC or media volume (cu ft)	72	180	288
GAC amount (pounds)	2,000	5,000	8,000
Recommended max flow rate (cfm)	1,100	2,500	4,500
Weight, empty (pounds)	1,760	3,340	4,900
Approximate operating weight (pounds)	3,760	8,340	12,900
Cross sectional area; square feet	16	36	64
Overall Height (A) in. (approx)	78	103	103
Width of side (B) in. +/- ¼"	49	73	97
Inlet /Outlet (C) 150# RF flange	6	8	12
Height to inlet (D) in. (approx)	8	10	13
Height to outlet (E) in. (approx)	70	92.5	89
Length including inlet/outlet flanges (F) +/-	52	77	101
Width of Forkguides (G) in	36	48	48

PROTECT VS
Carbon Adsorber Canisters

CalgonCarbon™

Safety Considerations

While complying with the recommended installation instructions, plant operators should also be aware of these additional heat-related safety considerations:

- When in contact with activated carbon, some types of organic chemical compounds, such as those from the ketone and aldehyde families and some organic acids or organic sulfur compounds, may react on the carbon surface causing severe exotherms or temperature excursions. **If you are unaware or unsure of the reaction of an organic compound on activated carbon, appropriate tests should be performed before placing a PROTECT VS canister in service.**
- Heat of adsorption can lead to severe temperature excursions at high concentrations of organic compounds in the inlet air or vapor. Heating may be controlled by diluting the inlet air or adding water vapor as a heat sink, by time weighting the inlet concentration to allow heat to dissipate, or by pre-wetting the carbon.
- **Do not use PROTECT VS canisters with ST1-X carbon in petrochemical or chemical industry applications.**
- ST1-X carbon can liberate heat by reacting chemically with oxygen. To prevent heat buildup within a canister, the carbon must not be confined without adequate air flow to dissipate the heat. In situations where there is insufficient or disrupted air flow through the vessel, the chemical reaction can be prevented by sealing the inlet and outlet connections to the canister.

Safety Message

Activated carbon will preferentially remove oxygen from air. In closed or partially closed containers or vessels, oxygen depletion may reach hazardous levels. If workers are to enter a container or vessel containing activated carbon, appropriate air sampling and work procedures for potentially low oxygen content spaces should be followed, including all applicable Federal and State requirements.

Warranty

Calgon Carbon Corporation warrants that the PROTECT VS canister will be free from defects in materials and workmanship for a period of 90 days following the date of purchase. In the event of a breach of this warranty, Calgon Carbon Corporation will, in its discretion, repair or replace any defective parts or the complete unit during the warranty period. This warranty does not apply to defects caused by (i) normal wear and tear, (ii) accident, disaster or event of force majeure, (iii) misuse, fault or negligence of or by Buyer, (iv) use of the PROTECT VS canister in a manner for which it is not designed, (v) external causes such as, but not limited to, power failure or electrical power surges, or (vi) improper storage and handling of the PROTECT VS canister. **Except as expressly provided in this warranty statement, Calgon Carbon Corporation disclaims all other warranties, whether express or implied, oral or written, including without limitations all implied warranties or merchantability or fitness for particular purpose. Calgon Carbon Corporation does not warrant that the PROTECT VS canisters are error-free or will accomplish any particular result. Any advice or assistance furnished by Calgon Carbon Corporation in relation to the PROTECT VS canister provided for hereunder shall not give rise to any warranty or guarantee of any kind. This warranty will take precedence over any and all other warranties unless specifically disclaimed and referenced by Calgon Carbon Corporation.**

Limitations of Liability

Carbon Carbon Corporation' liability and the Buyer's exclusive remedy for any cause of action arising out this transaction, including, but not limited to, breach of warranty, negligence and/or indemnification, is expressly limited to a maximum of the purchase price of the canister sold hereunder. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. Under no circumstance shall Calgon Carbon Corporation be liable for any incidental, consequential, punitive, exemplary, or special damages of any kind arising as a result of or in connection with the PROTECT VS canisters regardless of the cause giving rise to any claim. Nor shall Calgon Carbon Corporation be liable for loss of profits or fines imposed by governmental agencies. In no event shall Calgon Carbon Corporation's liability exceed the purchase price paid by purchaser, for any reason, whether by reason of breach of contract, tort, indemnification, warranty or otherwise. This limitation of liability statement will take precedence over any and all other liability provisions unless specifically disclaimed and referenced by Calgon Carbon Corporation.

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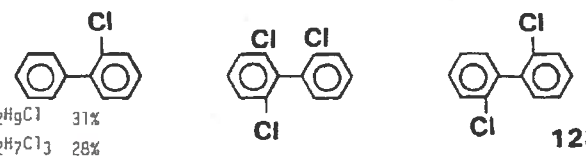
COMPOUND: PCB-1232

STRUCTURE:



1232

FORMULA: $C_{12}H_9Cl$ 31%, $C_{12}H_7Cl_3$ 28%, $C_{12}H_8Cl_2$ 24%

MOL. WT. ~ 232.2

FREUNDLICH PARAMETERS	pH		
K	630		
1/n	0.73		
Corr. Coef. r	0.98		
INITIAL CONC. mg/l	**ADSORPTION CAPACITY, mg/gm**		
1.0	630		
0.1	120		
0.01	22		
0.001	4.0		

CALCULATED CARBON REQUIREMENTS TO ACHIEVE INDICATED CHANGE IN CONCENTRATION (a)

SINGLE STAGE POWDERED CARBON

C_f, mg/l

C_0, mg/l	0.1	0.01	0.001
1.0	7.7	45	240
0.1		4.1	24
0.01			2.2

GRANULAR CARBON COLUMN

C_0, mg/l	
1.0	1.6
0.1	0.8
0.01	0.5

(a) Carbon doses in mg/l at neutral pH.

ANALYTICAL METHOD: Solvent - extraction - G.C.

REMARKS: Structures shown are for major components.

"Carbon Adsorption Isotherms for Toxic Organics"
United States Environmental Protection Agency, Municipal Environmental Research Laboratory, Cincinnati, OH 45268
April 1980

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Last updated on 11/14/2014

CalgonCarbon

FILTRASORB® 400

Granular Activated Carbon

Description

FILTRASORB 400 is a granular activated carbon developed by Calgon Carbon Corporation for the removal of dissolved organic compounds from water and wastewater as well as industrial and food processing streams. These contaminants include taste and odor compounds, organic color, total organic carbon (TOC), and industrial organic compounds such as TCE and PCE. This activated carbon is made from select grades of bituminous coal through a process known as reagglomeration to produce a high activity, durable, granular product capable of withstanding the abrasion associated with repeated backwashing, hydraulic transport, and reactivation for reuse. Activation is carefully controlled to produce a significant volume of both low and high energy pores for effective adsorption of a broad range of high and low molecular weight organic contaminants. FILTRASORB 400 is also formulated to comply with all the applicable provisions of the AWWA Standard for Granular Activated Carbon (B604), the stringent extractable metals requirements of ANSI/NSF Standard 61, and the Food Chemicals Codex.

Features

- Calgon Carbon's reagglomerated coal-based granular activated carbons have several properties which provide superior performance in a wide range of applications.
- Produced from a pulverized blend of high quality bituminous coals resulting in a consistent, high quality product.
- The activated carbon granules are uniformly activated through the whole granule, not just the outside. This results in excellent adsorption properties and constant adsorption kinetics in a wide range of applications.
- The reagglomerated structure ensures proper wetting while also eliminating floating material.
- High mechanical strength relative to other raw materials, thereby reducing the generation of fines during backwashing and hydraulic transport.
- Carbon bed segregation is retained after repeated backwashing, ensuring the adsorption profile remains unchanged and therefore maximizing the bed life.
- Reagglomerated with a high abrasion resistance, which provides excellent reactivation performance.
- High density carbon resulting in a greater adsorption capacity per unit volume.

Specifications	FILTRASORB 400
Iodine Number	1000 mg/g (min)
Moisture by Weight	2% (max)
Effective Size	0.55 - 0.75 mm
Uniformity Coefficient	1.9 (max)
Abrasion Number	75 (min)
Screen Size by Weight, US Sieve Series	
On 12 mesh	5% (max)
Through 40 mesh	4% (max)

Typical Properties*	FILTRASORB 400
Apparent Density	0.54 g/cc
Water Extractables	<1%
Non-Wettable	<1%

*For general information only, not to be used as purchase specifications.

Recycling by Thermal Reactivation

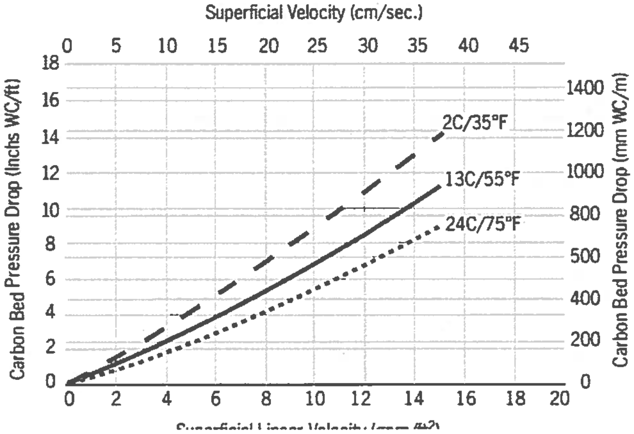
After a granular activated carbon's adsorptive capacity has been exhausted, it can be returned to Calgon Carbon for thermal reactivation. The thermal reactivation process involves a high temperature reaction with steam, which destroys the adsorbed organic compounds and restores the adsorptive capacity of the activated carbon.

Through reactivation, the spent activated carbon can be recycled for reuse, eliminating the costs and long-term liability associated with disposal of spent GAC. The benefits of a reactivated product over a virgin carbon are several, including economic, as reactivated GAC cost less than virgin GAC and environmental, as reactivated GAC conserves natural resources and reduces CO_2 emissions compared to the manufacture of virgin GAC. A further benefit of reactivating and reusing spent granular activated carbon is the ability for customers to ensure for themselves a reliable supply of media when needed, as the spent/reactivated carbon represents a renewable resource.

FILTRASORB 400 is designed with high mechanical strength and a dense, fully-developed pore structure to ensure low losses throughout the reactivation process and excellent adsorption performance upon reuse.

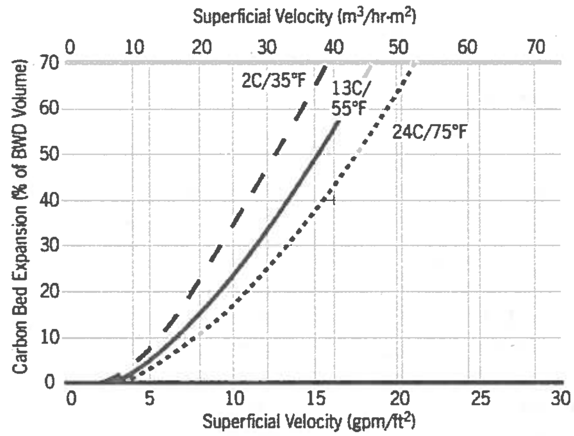
Pressure Drop

Based on Backwashed and Segregated Bed



Bed Expansion

Based on Backwashed and Segregated Bed



Applications

FILTRASORB 400 activated carbon can be used in a variety of liquid phase applications for the removal of dissolved organic compounds. FILTRASORB 400 has been successfully applied for over 40 years in applications such as drinking and process water purification, wastewater treatment, and food, pharmaceutical, and industrial purification.

Design Considerations

FILTRASORB 400 activated carbon is typically applied in down-flow packed-bed operations using either pressure or gravity systems. Design considerations for a treatment system is based on the user's operating conditions, the treatment objectives desired, and the chemical nature of the compound(s) being adsorbed.

Packaging

55 lb. (25 kg) poly bag

1,000 lb. (454 kg) super sack

Bulk truck

Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements. Please refer to the MSDS for all up to date product safety information.

Filtrasorb is 100% freshly manufactured virgin granular activated carbon. Recycled granular activated carbon is not used in the production of Filtrasorb.

Making Water and Air Safer and Cleaner

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Your local representative

1012

CalgonCarbon

Modular Ion Exchange Systems

Description

Calgon Carbon Ion Exchange Systems are designed for the removal of dissolved ionic compounds from water or other liquids using ion exchange resin. The modular design concept allows for selection of options or alternate materials to best meet the requirements of the site and treatment objectives.

Each system is delivered as dual vessels with a separate compact center piping network and interconnecting piping, requiring minimal space and field assembly. The pre-engineered design assures that the system performs as desired with minimal design engineering input. The design has the benefit of Calgon Carbon's extensive expertise and has been proven in numerous applications. The engineering package can be provided quickly and the system expedited through Calgon Carbon's production facilities.

The process piping network accommodates operation of the two ion exchange vessels in parallel or series flow, with either vessel in the lead position. The piping can also isolate either vessel for resin exchange or backwash operations, while maintaining flow through the other vessel. In addition, the Calgon Carbon underdrain design provides for efficient use of the resin through uniform collection of water at the bottom of the bed and even distribution of backwash water to minimize resin bed disturbance.

All systems are designed for use with Calgon Carbon's closed loop resin exchange service. Using specially designed food grade resin transport trailers, the spent resin can be removed from the vessel via pressurized resin-water slurry; fresh resin is refilled in the same manner. This closed loop transfer is accomplished without exposure of personnel to either spent or fresh resin. Calgon Carbon can also manage the disposal or regeneration services of the spent resin.

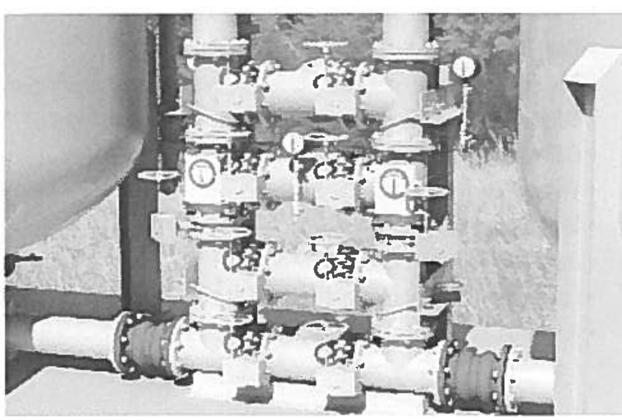
Benefits and Design Features

- Proven Design with Numerous Installations Worldwide
- CFD Optimized Internal Underdrain with Stainless Steel Septa
  - Uniform Flow Distribution
  - Better Resin Utilization
  - Lower Pressure Drop
  - Efficient Backwashing
- Carbon Steel ASME Code Stamped Pressure Vessels
  - Higher Pressures Available
  - External Underdrain Option
- Turnkey Resin Change Out Services
  - Removal and Disposal
  - Pre-Rinsing
  - Regeneration Option
- Easily Integrated with Granular Activated Carbon and Other Treatment Technologies
- Financing Options Available
  - Purchase
  - Lease
  - Lease to Own

Standard Features

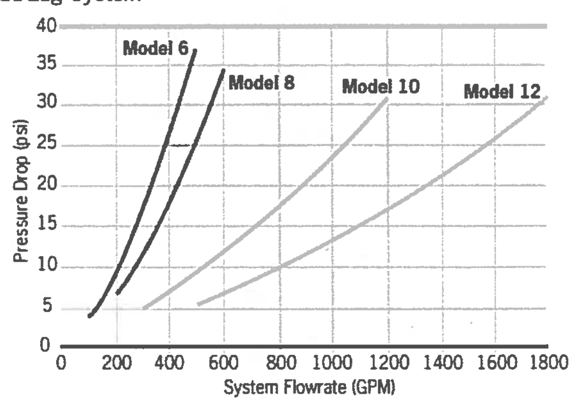
- Schedule 40 Carbon Steel Process Piping with Cast Iron Fittings
- Conical Resin Trap on Each Vessel
- Three In-Bed Water Sample Collection Probes
- Cast Iron or Steel Butterfly Process Valves
- Full Bore Stainless Steel Ball Valves on Resin Fill and Discharge
- Schedule 10 Stainless Steel Resin Fill and Discharge Pipes
- Differential Pressure Switch Per Vessel
- Three Pressure Gauges Per System
- Vinyl Ester Interior Lining (NSF)
- High Solids Epoxy Exterior Coating
- Emergency Pressure Relief Rupture Discs
- Air Pressurized Slurry Resin Transfer

Specifications	Units	Model 6	Model 8	Model 10	Model 12
Vessel Diameter	ft (mm)	6 (1830)	8 (2440)	10 (3050)	12 (3660)
Design Pressure at 140°F (60°C)	psig (kPa)	75 (517)	125 (862)	125 (862)	125 (862)
Process and Backwash Piping	in (mm)	4 (100) or 6 (150)	4 (100) or 6 (150)	6 (150) or 8 (200)	8 (200) or 10 (250)
Process Pipe Connection	—	150# ANSI flange			
Vessel Underdrain	—	Internal Ring Header(s) with SS Wedgewire Septa		Internal Cone with 80 - 120 SS Wedgewire Septa	
Utility Air and Water Connections	—	3/4" hose			
Utility Air	—	100 scfm (170 Nm^3/hr) at 30 psig (206 kPa) - Reduce to 15 psig (103 kPa) for Trailer			
Utility Water	—	100 GPM (23 m^3/hr) at 30 psig (206 kPa)			
Resin Hose Connections	—	3" Kamlock Type	4" Kamlock Type	4" Kamlock Type	4" Kamlock Type
Backwash Connections	in (mm)	4 (100) or 6 (150)	4 (100) or 6 (150)	6 (150) or 8 (200)	8 (200) or 10 (250)
Drain/Vent Connections	in (mm)	4 (100) or 6 (150)	4 (100) or 6 (150)	6 (150) or 8 (200)	8 (200) or 10 (250)
Vessel Maintenance Access	—	20" (500 mm) Round Flanged Side Manway		20" (500 mm) Round Flanged Side Manway and 14"x18" (356 x 460 mm) Manway Below the Cone	
Vessel Shipping Weight Empty	lbs (kg)	5,000 (2,300)	8,000 (3,700)	16,500 (7,500)	19,500 (8,850)
System Operating Weight	lbs (kg)	42,000 (19,000)	92,000 (41,800)	215,000 (97,520)	265,000 (123,250)
Overall Footprint per System	L x W x H ft (mm)	17 x 8 x 16.5 (5200 x 2400 x 5000)	22 x 9.5 x 16.5 (6700 x 2900 x 5000)	26 x 11 x 22 (8000 x 3350 x 6700)	32 x 13.5 x 13 (9800 x 4150 x 4000)
Recommended Flow Rate (Series Operation)	GPM (m^3/hr)	100 - 500 (23 - 114)	200 - 600 (45 - 137)	300 - 1200 (68 - 273)	500 - 1800 (114 - 409)
Resin per Vessel	ft^3 (m^3)	106 (3)	212 (6)	353 (10)	424 (12)
Backwash Rate - 50% Expansion	GPM (m^3/hr)	50 (11)	85 (19)	130 (30)	190 (43)



Typical Pressure Drop

Lead-Lag System



Note: Assumes clean and backwashed bed.

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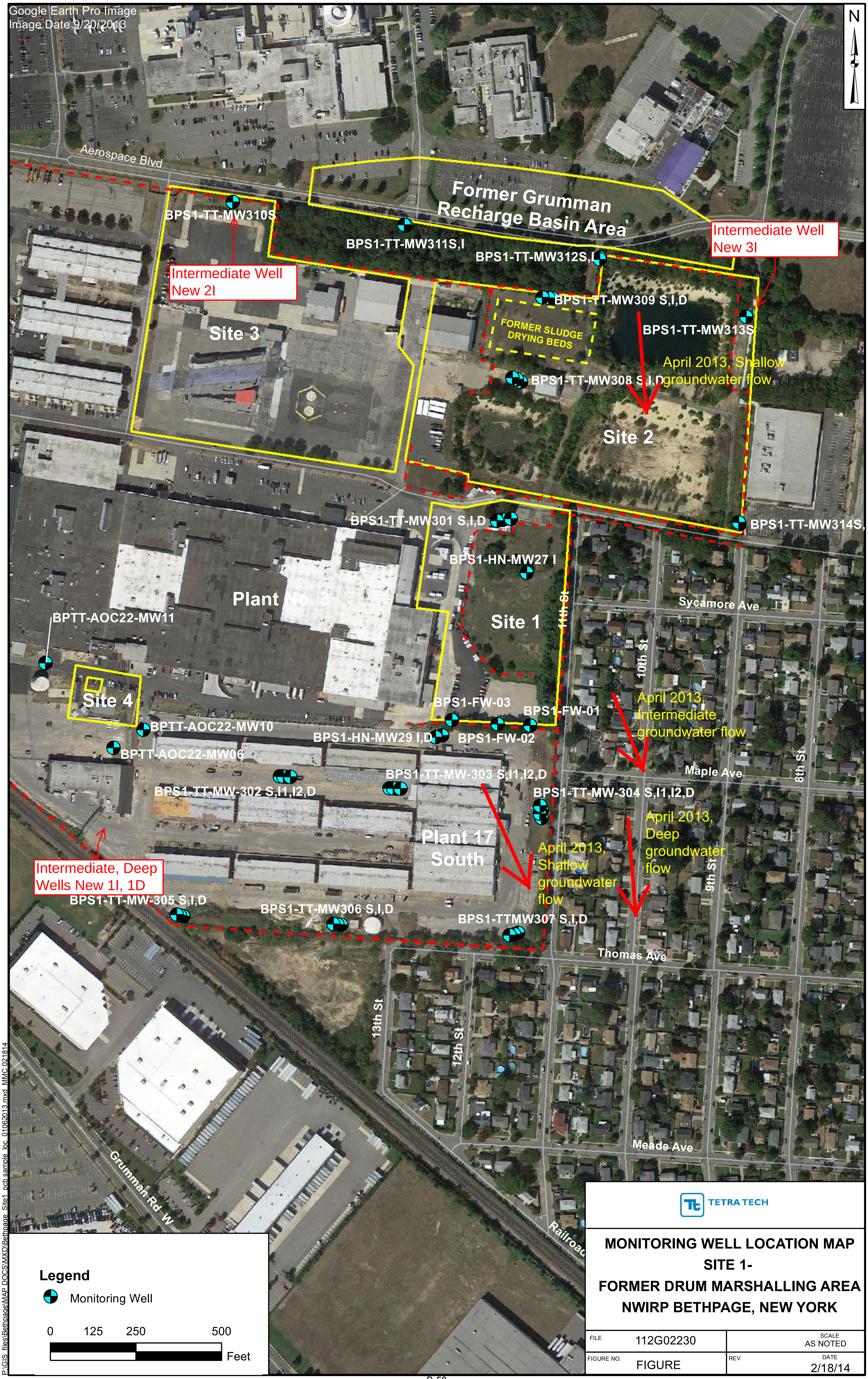
Your local representative

Tetra Tech, Inc.		***STANDARD CALCULATION SHEET***	
CLIENT:	FILE No:	BY: SK	PAGE:
SUBJECT: Appendix B Monitoring well sampling list Site 1 Bethpage, New York		CHECKED BY:	DATE: 11/3/2014

North Sites 2,3	Shallow	BPS1-TT-MW310S, BPS1-TT-MW312S, BPS1-TT-MW313S
	Intermediate	BPS1-TT-MW311I, New2I, New 3I
	Deep	BPS1-TT-MW308D
Recharge Basins	Shallow	BPS1-TT-MW314S
	Intermediate	BPS1-TT-MW314I
	Deep	BPS1-TT-MW309D
North Site 1	Shallow	BPS1-TT-MW301S
	Intermediate	BPS1-TT-MW301I
	Deep	BPS1-TT-MW301D
South Site 1	Shallow	BPS1-FW-01, BPTT-AOC22-MW11, BPS1-TT-MW304S
	Intermediate	BPS1-TT-MW-302I2, TT-MW-304I2, New1I
	Deep	BPS1-TT-MW-302D, TT-MW304D, New1D
Border Site 1	Shallow	BPS1-TT-MW-305S, BPS1-TT-MW307S
	Intermediate	BPS1-TT-MW-305I, BPS1-TT-307I
	Deep	BPS1-TT-MW-305D, BPS1-TT-307D

28 Wells total; 24 existing, 4 new
Highlighted cells indicate new wells.



TETRA TECH

MONITORING WELL LOCATION MAP
SITE 1-
FORMER DRUM MARSHALLING AREA
NWIRP BETHPAGE, NEW YORK

FILE	112G02230	SCALE	AS NOTED
FIGURE NO.	FIGURE	REV	DATE 2/18/14

APPENDIX C

COST ESTIMATES

Alternative S-1
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-1 - No Action

Capital Cost:	$0
O&M:	$0
NPV:	$0

Alternative S-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-2 - Permeable Cover, Limited Excavation and Offsite Disposal, and Land Use Controls

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Planning Documents	1	LS	$25,000	$25,000
1.2	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.3	Pre-characterization Analysis (SVOCs, Metals, PCBs, and a pesticide)	162	Each	$350	$56,700
1.4	Waste Characterization Analysis (RCRA)	29	Each	$900	$26,100
1.5	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$121,800**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, electrical connection)	18	month	$3,000	$54,000
2.2	Utility Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	18	Month	$1,000	$18,000
2.5	Material staging area	18	Month	$1,000	$18,000
2.6	Heavy Equipment mob/demob	4	Each	$5,000	$20,000
2.7	Confirmation Sampling	81	Each	$405	$32,805
	Subtotal (Item 2)				**$187,805**

Alternative S-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3.	**Excavation, Disposal, and Permeable Cover**				
3a.	**Site 1 Excavation**				
3.1	Site Clearing and Disposal	1	LS	$10,000	$10,000
3.2	Demolition Settling Tank, Tops Cesspools	500	Tons	$160	$80,000
3.3	Soil Transport, and Dispose, Hazardous	10,875	Tons	$480	$5,220,000
3.4	Soil Transport, and Dispose, Non-Hazardous	10,875	Tons	$160	$1,740,000
3.5	Equipment (Loader)	10	Month	$3,200	$32,000
3.6	Equipment (Dozer/Compactor)	10	Month	$2,900	$29,000
3.7	Equipment (Excavator)	10	Month	$10,975	$109,750
3.8	Equipment (Loader)	10	Month	$3,200	$32,000
3.9	Labor - Operators (3)	30	Person-Month	$11,870	$356,100
3.10	Labor - Laborers (2)	20	Person-Month	$9,744	$194,880
3b.	**Site 1 Cover**				
3.11	6 Inch Gravel/Top Soil Cover	4,876	Tons	$44.15	$215,275
3.12	18 inch soil cover (state sand, backfill)	16,389	Tons	$24.50	$401,531
3.13	Equipment (Loader)	8	Month	$3,200	$25,600
3.14	Equipment (Dozer/Compactor)	8	Month	$2,900	$23,200
3.15	Equipment (Excavator)	8	Month	$10,975	$87,800
3.16	Equipment (Loader)	8	Month	$3,200	$25,600
3.17	Labor - Operators (3)	24	Person-Month	$11,870	$284,880
3.18	Labor - Laborers (2)	16	Person-Month	$9,744	$155,904
3c.	**General**				
3.19	Misc Construction Supplies	18	Month	$500	$9,000
3.20	Fuel (2,000 gallons per month)	36,000	Gallons	$5	$180,000
3.21	Fuel cube	18	Month	$575	$10,350
	Subtotal (Item 3)				**$9,222,870**

Alternative S-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	Tons	$24.50	$43,659
4b.	**General**				
4.3	Landscaping	1	LS	$20,000	$20,000
4.4	Material Staging Area Removal	1	Week	$18,000	$18,000
4.5	Decon of Equipment	4	Each	$5,000	$20,000
4.6	General Construction Debris Removal	4	Each	$5,000	$20,000
4.7	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.8	Establish Vegetation	16	Day	$200	$3,200
4.9	Water for Vegetation	1	LS	$1,000	$1,000
4.10	Materials for Watering Vegetation	1	LS	$5,000	$5,000
	Subtotal (Item 4)				**$149,164**
5	**Labor**				
5.1	Construction Oversight (Supervisor)	18	Month	$23,100	$415,800
5.2	Construction Oversight (QA/QC)	18	Month	$19,900	$358,200
5.3	Oversight (H&S, Supervisor)	9	Month	$19,900	$179,100
5.4	Office Support	18	Month	$19,900	$358,200
	Subtotal (Item 5)				**$1,311,300**
6	**Construction Close Out Reporting**	1	LS	$30,000	**$30,000**
	Subtotal (Capital)				$9,711,639
	Contingency (20%)				$1,942,328
	Design & Engineering (13%)				$1,262,513
	Total Construction Cost				**$12,916,480**

Alternative S-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Annual O&M Cost (S-2)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
7	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
8	**Cover Maintenance**				
8.1	Gravel	13.5	Tons	$44.15	$596
8.2	Mowing	4.5	Acre	$1,000	$4,500
8.3	Fence Repair	50	Foot	$14.00	$700
8.4	Vegetation Repair	1	LS	$2,000	$2,000
8.5	Field Labor	5	Day	$995	$4,975
	Subtotal (Item 8)				**$12,771**

Cost Summary (without discount factor).

		Capital	O&M	Duration (year)	Total Cost
1.	Delineation/Waste-Characterization	$121,800	$0	1	$121,800
2.	General Mobilization/Demobilization	$187,805	$0	1	$187,805
3.	Excavation, Disposal, and Permeable Cover	$9,222,870	$0	1	$9,222,870
4	Site Restoration	$149,164	$0	1	$149,164
5	Labor	$1,311,300	$0	1	$1,311,300
6.	Construction Close Out Reporting	$30,000	$0	1	$30,000
7.	5-Year Review/LUCs	$0	$30,000	6	$180,000
8	Cover Maintenance	$0	$12,771	30	$383,131
	Total Alternative S-2	$12,916,480	$42,771		

Alternative S-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

	Dec-15		
As of		interest rate (OBM)	1.40%

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 12,916,480	0	$ -	$ 12,916,480	1	$12,916,480
1	$ -	$12,771	-	$12,771	0.986	$12,595
2	$ -	$12,771	-	$12,771	0.973	$12,421
3	$ -	$12,771	-	$12,771	0.959	$12,249
4	$ -	$12,771	-	$12,771	0.946	$12,080
5	$ -	$42,771	-	$42,771	0.933	$39,899
6	$ -	$12,771	-	$12,771	0.920	$11,749
7	$ -	$12,771	-	$12,771	0.907	$11,587
8	$ -	$12,771	-	$12,771	0.895	$11,427
9	$ -	$12,771	-	$12,771	0.882	$11,269
10	$ -	$42,771	-	$42,771	0.870	$37,219
11	$ -	$12,771	-	$12,771	0.858	$10,960
12	$ -	$12,771	-	$12,771	0.846	$10,809
13	$ -	$12,771	-	$12,771	0.835	$10,659
14	$ -	$12,771	-	$12,771	0.823	$10,512
15	$ -	$42,771	-	$42,771	0.812	$34,720
16	$ -	$12,771	-	$12,771	0.801	$10,224
17	$ -	$12,771	-	$12,771	0.790	$10,083
18	$ -	$12,771	-	$12,771	0.779	$9,944
19	$ -	$12,771	-	$12,771	0.768	$9,806
20	$ -	$42,771	-	$42,771	0.757	$32,388
21	$ -	$12,771	-	$12,771	0.747	$9,537
22	$ -	$12,771	-	$12,771	0.736	$9,406
23	$ -	$12,771	-	$12,771	0.726	$9,276
24	$ -	$12,771	-	$12,771	0.716	$9,148
25	$ -	$42,771	-	$42,771	0.706	$30,213
26	$ -	$12,771	-	$12,771	0.697	$8,897
27	$ -	$12,771	-	$12,771	0.687	$8,774
28	$ -	$12,771	-	$12,771	0.678	$8,653
29	$ -	$12,771	-	$12,771	0.668	$8,533
30	$ -	$42,771	-	$42,771	0.659	$28,185
					Total Present Worth =	$13,369,702

Alternative S-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-3 - RCRA Cap, Limited Excavation and Offsite Disposal, and Land Use Controls

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Planning Documents	1	LS	$25,000	$25,000
1.2	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.3	Pre-characterization Analysis (SVOCs, Metals, PCBs and a pesticide)	162	Each	$350	$56,700
1.4	Waste Characterization Analysis (RCRA)	15	Each	$900	$13,500
1.5	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$109,200**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities)	21	month	$3,000	$63,000
2.2	Utility Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	21	Month	$1,000	$21,000
2.5	Material staging area	21	Month	$1,000	$21,000
2.6	Heavy Equipment mob/demob	5	Each	$5,000	$25,000
2.7	Confirmation Sampling	81	Each	$405	$32,805
	Subtotal (Item 2)				**$207,805**

Alternative S-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3.	**Excavation, Disposal, and RCRA Cap**				
3a.	**Site 1 Excavation & Disposal**				
3.1	Site Clearing	1	Week	$10,000	$10,000
3.2	Demolition Settling Tank, Tops Cesspools	500	Tons	$160	$80,000
3.3	Soil Transport, and Dispose Hazardous	8,127	Tons	$480	$3,900,960
3.4	Soil Transport, and Dispose Non-hazardous	2,709	Tons	$160	$433,440
3.5	Equipment (Loader) (2)	7	Month	$3,200	$44,800
3.6	Equipment (Dozer/Compactor)	7	Month	$2,900	$20,300
3.7	Equipment (Excavator)	7	Month	$10,975	$76,825
3.8	Equipment (Truck)	7	Month	$3,200	$22,400
3.9	Labor- Operators (4)	28	Person-Month	$11,867	$332,276
3.10	Labor-Laborers (2)	14	Person-Month	$9,744	$136,416
3b.	**Site 1 RCRA Cap**				
3.11	2 Feet Compacted Clay	23,000	Tons	$62	$1,426,000
3.12	1 Foot Gravel	9,751	Tons	$44.15	$430,507
3.13	18 Inches Fill	16,389	Tons	$24.50	$401,531
3.14	6 Inches Top Soil	5,454	Tons	$22.50	$122,715
3.15	Geofabric	262,500	SF	$0.09	$23,625
3.16	80-mil HDPE geomembrane	87,500	SF	$1.32	$115,500
3.17	Equipment (Loader) (2)	14	Month	$3,200	$89,600
3.18	Equipment (Dozer/Compactor)	14	Month	$2,900	$40,600
3.19	Equipment (Excavator)	14	Month	$10,975	$153,650
3.20	Equipment (Truck)	14	Month	$3,200	$44,800
3.21	Labor- Operators (3)	42	Person-Month	$11,867	$498,414
3.22	Labor-Laborers (2)	28	Person-Month	$9,744	$272,832
3c.	**General**				
3.23	Misc Construction Supplies	21	Month	$500	$10,500
3.24	Fuel (2,000 gallons a month)	42,000	Gallons	$5	$210,000
3.25	Fuel Cube	21	Month	$575	$12,075
	Subtotal (Item 3)				**$8,909,765**

Alternative S-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	Tons	$24.50	$43,659
4b.	**General**				
4.3	Landscaping	1	LS	$20,000	$20,000
4.4	Material Staging Area Removal	1	Week	$18,000	$18,000
4.5	Decon of Equipment	5	Each	$5,000	$25,000
4.6	General Construction Debris Removal	4	Each	$5,000	$20,000
4.7	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.8	Establish Vegetation	16	Day	$200	$3,200
4.9	Water for Vegetation	1	LS	$1,000	$1,000
4.10	Materials for Watering Vegetation	1	LS	$5,000	$5,000
	Subtotal (Item 4)				**$154,164**
5	**Labor**				
5.1	Construction Oversight (Supervisor)	21	Month	$23,100	$485,100
5.2	Construction Oversight (QA/QC)	21	Month	$19,900	$417,900
5.3	Oversight (H&S, Supervisor)	11	Month	$19,900	$218,900
5.4	Office Support	21	Month	$19,900	$417,900
	Subtotal (Item 5)				**$1,539,800**
6.	**Construction Close Out Reporting**	1	LS	$30,000	**$30,000**
	Subtotal (Capital)				$10,950,734
	Contingency (20%)				$2,190,147
	Design & Engineering (13%)				$1,423,595
	Total Construction Cost				**$14,564,476**

Alternative S-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Annual O&M Cost (S-3)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
7	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
8	**Cap Maintenance**				
8.1	Miscellaneous Materials	13.5	Tons	$44.15	$596
8.2	Mowing	4.5	Acre	$1,000	$4,500
8.3	Fence Repair	50	Foot	$14.00	$700
8.4	Vegetation Repair	1	LS	$2,000	$2,000
8.5	Field Labor	5	Day	$995	$4,975
	Subtotal (Item 8)				**$12,771**

Cost Summary (without discount factor).

		Capital	O&M	Duration (year)	Total Cost
1	Delineation/Waste-Characterization	$109,200	$0	1	$109,200
2	General Mobilization/Demobilization	$207,805	$0	1	$207,805
3	Excavation, Disposal, and RCRA Cap	$8,909,765	$0	1	$8,909,765
4	Site Restoration	$154,164	$0	1	$154,164
5	Labor	$1,539,800	$0	1	$1,539,800
6	Construction Close Out Reporting	$30,000	$0	1	$30,000
7	5-Year Review/LUCs	0	$30,000	6	$180,000
8	Cap Maintenance	0	$12,771	30	$383,131
	Total Alternative S-3	$14,564,476	$42,771		

Alternative S-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

	Dec-15				
As of		interest rate (OBM)	1.40%		

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 14,564,476	0	$ -	$ 14,564,476	1	$14,564,476
1	$ -	$12,771	-	$12,771	0.986	$12,595
2	$ -	$12,771	-	$12,771	0.973	$12,421
3	$ -	$12,771	-	$12,771	0.959	$12,249
4	$ -	$12,771	-	$12,771	0.946	$12,080
5	$ -	$42,771	-	$42,771	0.933	$39,899
6	$ -	$12,771	-	$12,771	0.920	$11,749
7	$ -	$12,771	-	$12,771	0.907	$11,587
8	$ -	$12,771	-	$12,771	0.895	$11,427
9	$ -	$12,771	-	$12,771	0.882	$11,269
10	$ -	$42,771	-	$42,771	0.870	$37,219
11	$ -	$12,771	-	$12,771	0.858	$10,960
12	$ -	$12,771	-	$12,771	0.846	$10,809
13	$ -	$12,771	-	$12,771	0.835	$10,659
14	$ -	$12,771	-	$12,771	0.823	$10,512
15	$ -	$42,771	-	$42,771	0.812	$34,720
16	$ -	$12,771	-	$12,771	0.801	$10,224
17	$ -	$12,771	-	$12,771	0.790	$10,083
18	$ -	$12,771	-	$12,771	0.779	$9,944
19	$ -	$12,771	-	$12,771	0.768	$9,806
20	$ -	$42,771	-	$42,771	0.757	$32,388
21	$ -	$12,771	-	$12,771	0.747	$9,537
22	$ -	$12,771	-	$12,771	0.736	$9,406
23	$ -	$12,771	-	$12,771	0.726	$9,276
24	$ -	$12,771	-	$12,771	0.716	$9,148
25	$ -	$42,771	-	$42,771	0.706	$30,213
26	$ -	$12,771	-	$12,771	0.697	$8,897
27	$ -	$12,771	-	$12,771	0.687	$8,774
28	$ -	$12,771	-	$12,771	0.678	$8,653
29	$ -	$12,771	-	$12,771	0.668	$8,533
30	$ -	$42,771	-	$42,771	0.659	$28,185
					Total Present Worth =	$15,017,698

Alternative S-4
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-4 - RCRA Cap, Limited Excavation and Offsite Disposal, Vertical Barriers, and Land Use Controls

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Planning Documents	1	LS	$25,000	$25,000
1.2	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.3	Pre-characterization Analysis (SVOCs, Metals, PCBs and a pesticide)	162	Each	$350	$56,700
1.4	Waste Characterization Analysis (RCRA)	15	Each	$900	$13,500
1.5	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$109,200**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities)	40	month	$3,000	$120,000
2.2	Utility Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	40	Month	$1,000	$40,000
2.5	Material staging area	40	Month	$1,000	$40,000
2.6	Heavy Equipment mob/demob	6	Each	$5,000	$30,000
2.7	Confirmation Sampling	81	Each	$405	$32,805
	Subtotal (Item 2)				**$307,805**

Alternative S-4
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3.	**Excavation, Disposal, and RCRA Cap**				
3a.	**Site 1 Excavation and Disposal**				
3.1	Site Clearing	1	Week	$10,000	$10,000
3.2	Demolition Settling Tank, Tops Cesspools	500	Tons	$160	$80,000
3.3	Soil Transport, and Dispose Hazardous	8,127	Tons	$480	$3,900,960
3.4	Soil & Excess Vertical Barrier Transport, and Dispose Non-hazardous	6,309	Tons	$160	$1,009,440
3.5	Equipment (Loader) (2)	7	Month	$3,200	$44,800
3.6	Equipment (Dozer/Compactor)	7	Month	$2,900	$20,300
3.7	Equipment (Excavator)	7	Month	$10,975	$76,825
3.8	Equipment (Truck)	7	Month	$3,200	$22,400
3.9	Labor- Operators (4)	28	Person-Month	$11,867	$332,276
3.10	Labor-Laborers (2)	14	Person-Month	$9,744	$136,416
3b.	**Site 1 RCRA Cap**				
3.11	2 Feet Compacted Clay	23,000	Tons	$62	$1,426,000
3.12	1 Foot Gravel	9,751	Tons	$44.15	$430,507
3.13	18 Inches Fill	16,389	Tons	$24.50	$401,531
3.14	6 Inches Top Soil	5,454	Tons	$22.50	$122,715
3.15	Geofabric	262,500	SF	$0.09	$23,625
3.16	80-mil HDPE geomembrane	87,500	SF	$1.32	$115,500
3.17	Equipment (Loader) (2)	14	Month	$3,200	$89,600
3.18	Equipment (Dozer/Compactor)	14	Month	$2,900	$40,600
3.19	Equipment (Excavator)	14	Month	$10,975	$153,650
3.20	Equipment (Truck)	14	Month	$3,200	$44,800
3.21	Labor- Operators (3)	42	Person-Month	$11,867	$498,414
3.22	Labor-Laborers (2)	28	Person-Month	$9,744	$272,832
3c.	**General**				
3.23	Misc Construction Supplies	21	Month	$500	$10,500
3.24	Fuel (2,000 gallons a week)	42,000	Gallons	$5	$210,000
3.25	Fuel Cube	21	Month	$575	$12,075
	Subtotal (Item 3)				**$9,485,765**

Alternative S-4
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	Tons	$24.50	$43,659
4b.	**General**				
4.3	Landscaping	1	LS	$20,000	$20,000
4.4	Material Staging Area Removal	1	Week	$18,000	$18,000
4.5	Decon of Equipment	6	Each	$5,000	$30,000
4.6	General Construction Debris Removal	4	Each	$5,000	$20,000
4.7	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.8	Establish Vegetation	16	Day	$200	$3,200
4.9	Water for Vegetation	1	LS	$1,000	$1,000
4.10	Materials for Watering Vegetation	1	LS	$5,000	$5,000
	Subtotal (Item 4)				**$159,164**
5	**Vertical Barrier**				
5.1	Mobilization	1	LS	$100,000	$100,000
5.2	Cement, Portland, Type I or II	9,200	CY	$150	$1,380,000
5.3	Drilling, Grout Mixing, and Injection	30	Month	$100,000	$3,000,000
5.4	Spoil Containment and Collection	30	Month	$20,000	$600,000
	Subtotal (Item 5)				**$5,080,000**
6	**Labor**				
6.1	Construction Oversight (Supervisor)	40	Month	$23,100	$924,000
6.2	Construction Oversight (QA/QC)	40	Month	$19,900	$796,000
6.3	Oversight (H&S, Supervisor)	20	Month	$19,900	$398,000
6.4	Office Support	40	Month	$19,900	$796,000
	Subtotal (Item 6)				**$2,914,000**
7.	**Construction Close Out Reporting**	1	LS	$30,000	**$30,000**
	Capital (Subtotal)				$18,085,934
	Contingency (20%)				$3,617,187
	Design & Engineering (13%)				$2,351,171
	Total Construction Cost				**$24,054,292**

Alternative S-4
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Annual O&M Cost (S-4)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
8	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
9	**Cap Maintenance**				
9.1	Miscellaneous Materials	13.5	Tons	$44.15	$596
9.2	Mowing	4.5	Acre	$1,000	$4,500
9.3	Fence Repair	50	Foot	$14.00	$700
9.4	Vegetation Repair	1	LS	$2,000	$2,000
9.5	Field Labor	5	Day	$995	$4,975
	Subtotal (Item 9)				**$12,771**

Cost Summary (without discount factor).

		Capital	O&M	Duration (year)	Total Cost
1	Delineation/Waste-Characterization	$109,200		1	$109,200
2	General Mobilization/Demobilization	$307,805		1	$307,805
3	Excavation, Disposal, and RCRA Cap	$9,485,765		1	$9,485,765
4	Site Restoration	$159,164		1	$159,164
5	Vertical Barrier	$5,080,000		1	$5,080,000
6	Labor	$2,914,000			
7	Construction Close Out Reporting	$30,000		1	$30,000
8	5-Year Review/LUCs		$30,000	6	$180,000
9	Cap Maintenance		$12,771	30	$383,131
	Total Alternative S-4	$24,054,292	$42,771		

Alternative S-4
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
	Dec-15 As of	interest rate (O	1.40%			
0	$ 24,054,292	0	$ -	$ 24,054,292	1	$24,054,292
1	$ -	$12,771	-	$12,771	0.986	$12,595
2	$ -	$12,771	-	$12,771	0.973	$12,421
3	$ -	$12,771	-	$12,771	0.959	$12,249
4	$ -	$12,771	-	$12,771	0.946	$12,080
5	$ -	$42,771	-	$42,771	0.933	$39,899
6	$ -	$12,771	-	$12,771	0.920	$11,749
7	$ -	$12,771	-	$12,771	0.907	$11,587
8	$ -	$12,771	-	$12,771	0.895	$11,427
9	$ -	$12,771	-	$12,771	0.882	$11,269
10	$ -	$42,771	-	$42,771	0.870	$37,219
11	$ -	$12,771	-	$12,771	0.858	$10,960
12	$ -	$12,771	-	$12,771	0.846	$10,809
13	$ -	$12,771	-	$12,771	0.835	$10,659
14	$ -	$12,771	-	$12,771	0.823	$10,512
15	$ -	$42,771	-	$42,771	0.812	$34,720
16	$ -	$12,771	-	$12,771	0.801	$10,224
17	$ -	$12,771	-	$12,771	0.790	$10,083
18	$ -	$12,771	-	$12,771	0.779	$9,944
19	$ -	$12,771	-	$12,771	0.768	$9,806
20	$ -	$42,771	-	$42,771	0.757	$32,388
21	$ -	$12,771	-	$12,771	0.747	$9,537
22	$ -	$12,771	-	$12,771	0.736	$9,406
23	$ -	$12,771	-	$12,771	0.726	$9,276
24	$ -	$12,771	-	$12,771	0.716	$9,148
25	$ -	$42,771	-	$42,771	0.706	$30,213
26	$ -	$12,771	-	$12,771	0.697	$8,897
27	$ -	$12,771	-	$12,771	0.687	$8,774
28	$ -	$12,771	-	$12,771	0.678	$8,653
29	$ -	$12,771	-	$12,771	0.668	$8,533
30	$ -	$42,771	-	$42,771	0.659	$28,185
					Total Present Worth =	$24,507,514

Alternative S-5A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative 5A - RCRA Cap, Limited Excavation and Offsite Disposal, In-situ Solidification, and Land Use Controls

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Planning Documents	1	LS	$25,000	$25,000
1.2	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.3	Pre-characterization Analysis (SVOCs, Metals, PCBs and a pesticide)	540	Each	$350	$189,000
1.4	Waste Characterization Analysis (RCRA)	20	Each	$900	$18,000
1.5	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$246,000**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities)	48	month	$3,000	$144,000
2.2	Utility Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	30	Month	$1,000	$30,000
2.5	Material staging area	48	Month	$1,000	$48,000
2.6	Heavy Equipment mob/demob	6	Each	$5,000	$30,000
2.7	Confirmation Sampling	81	Each	$405	$32,805
	Subtotal (Item 2)				**$329,805**
3.	**Excavation, Disposal, and RCRA Cap**				
3a.	**Site 1 Excavation and Disposal**				
3.1	Site Clearing	1	Week	$10,000	$10,000
3.2	Demolition Settling Tank, Tops Cesspools	500	Tons	$160	$80,000
3.3	Soil Transport, and Dispose Hazardous	11,727	Tons	$480	$5,628,960
3.4	Soil Transport, and Dispose Non-hazardous	2,709	Tons	$160	$433,440
3.5	Equipment (Loader) (2)	7	Month	$3,200	$44,800
3.6	Equipment (Dozer/Compactor)	7	Month	$2,900	$20,300
3.7	Equipment (Excavator)	7	Month	$10,975	$76,825
3.8	Equipment (Truck)	7	Month	$3,200	$22,400
3.9	Labor- Operators (4)	28	Person-Month	$11,867	$332,276
3.10	Labor-Laborers (2)	14	Person-Month	$9,744	$136,416

Alternative S-5A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3b.	**Site 1 RCRA Cap**				
3.11	2 Feet Compacted Clay	23,000	Tons	$62	$1,426,000
3.12	1 Foot Gravel	9,751	Tons	$44.15	$430,507
3.13	18 Inches Fill	607	Tons	$24.50	$14,872
3.14	6 Inches Top Soil	202	Tons	$22.50	$4,545
3.15	Geofabric	262,500	SF	$0.09	$23,625
3.16	80-mil HDPE geomembrane	87,500	SF	$1.32	$115,500
3.17	Equipment (Loader) (2)	14	Month	$3,200	$89,600
3.18	Equipment (Dozer/Compactor)	14	Month	$2,900	$40,600
3.19	Equipment (Excavator)	14	Month	$10,975	$153,650
3.20	Equipment (Truck)	14	Month	$3,200	$44,800
3.21	Labor- Operators (3)	42	Person-Month	$11,867	$498,414
3.22	Labor-Laborers (2)	28	Person-Month	$9,744	$272,832
3c.	**General**				
3.23	Misc Construction Supplies	21	Month	$500	$10,500
3.24	Fuel (2,000 gallons a week)	42,000	Gallons	$5	$210,000
3.25	Fuel Cube	21	Month	$575	$12,075
	Subtotal (Item 3)				**$10,132,936**

Alternative S-5A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	Tons	$24.50	$43,659
4b.	**General**				
4.3	Landscaping	1	LS	$20,000	$20,000
4.4	Material Staging Area Removal	1	Week	$18,000	$18,000
4.5	Decon of Equipment	6	Each	$5,000	$30,000
4.6	General Construction Debris Removal	4	Each	$5,000	$20,000
4.7	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.8	Establish Vegetation	16	Day	$200	$3,200
4.9	Water for Vegetation	1	LS	$1,000	$1,000
4.10	Materials for Watering Vegetation	1	LS	$5,000	$5,000
	Subtotal (Item 4)				**$159,164**
5	**Solidification**				
5.1	Mobilization	1	LS	$100,000	$100,000
5.2	Cement, Portland, Type I or II	6,400	CY	$150	$960,000
5.3	Drilling, Grout Mixing, and Injection	21	Month	$100,000	$2,100,000
5.4	Spoil Containment, Collection, and Disposal	21	Month	$20,000	$420,000
	Subtotal (Item 5)				**$3,580,000**
6	**Labor**				
6.1	Construction Oversight (Supervisor)	48	Month	$23,100	$1,108,800
6.2	Construction Oversight (QA/QC)	48	Month	$19,900	$955,200
6.3	Oversight (H&S, Supervisor)	24	Month	$19,900	$477,600
6.4	Office Support	48	Month	$19,900	$955,200
	Subtotal (Item 6)				**$3,496,800**
7	**Construction Close Out Reporting**	1	LS	$30,000	**$30,000**
	Capital (Subtotal)				$17,728,705
	Contingency (20%)				$3,545,741
	Design & Engineering (13%)				$2,304,732
	Total Construction Cost				**$23,579,178**

Alternative S-5A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Annual O&M Cost (S-5A)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
8	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
9	**Cap Maintenance**				
9.1	Miscellaneous Materials	13.5	Tons	$44.15	$596
9.2	Mowing	4.5	Acre	$1,000	$4,500
9.3	Fence Repair	50	Foot	$14.00	$700
9.4	Vegetation Repair	1	LS	$2,000	$2,000
9.5	Field Labor	5	Day	$995	$4,975
	Subtotal (Item 2)				**$12,771**

Cost Summary (without discount factor).

		Capital	O&M	Duration (year)	Total Cost
1	Delineation/Waste-Characterization	$246,000	$0	1	$246,000
2	General Mobilization/Demobilization	$329,805	$0	1	$329,805
3	Excavation, Disposal, and RCRA Cap	$10,132,936	$0	1	$10,132,936
4	Site Restoration	$159,164	$0	1	$159,164
5	Solidification	$3,580,000	$0	1	$3,580,000
6	Labor	$3,496,800	$0	1	$3,496,800
7	Construction Close Out Reporting	$30,000	$0	1	$30,000
8	5-Year Review/LUCs	$0	$30,000	6	$180,000
9	Cap Maintenance	$0	$12,771	30	$383,131
	Total Alternative S-5A	$23,579,178	$42,771		

Alternative S-5A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

As of	Dec-15
interest rate (OBM)	0.014%

Year	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 23,579,178	0	$ -	$ 23,579,178	1	$23,579,178
1	$ -	$12,771	-	$12,771	0.986	$12,595
2	$ -	$12,771	-	$12,771	0.973	$12,421
3	$ -	$12,771	-	$12,771	0.959	$12,249
4	$ -	$12,771	-	$12,771	0.946	$12,080
5	$ -	$42,771	-	$42,771	0.933	$39,899
6	$ -	$12,771	-	$12,771	0.920	$11,749
7	$ -	$12,771	-	$12,771	0.907	$11,587
8	$ -	$12,771	-	$12,771	0.895	$11,427
9	$ -	$12,771	-	$12,771	0.882	$11,269
10	$ -	$42,771	-	$42,771	0.870	$37,219
11	$ -	$12,771	-	$12,771	0.858	$10,960
12	$ -	$12,771	-	$12,771	0.846	$10,809
13	$ -	$12,771	-	$12,771	0.835	$10,659
14	$ -	$12,771	-	$12,771	0.823	$10,512
15	$ -	$42,771	-	$42,771	0.812	$34,720
16	$ -	$12,771	-	$12,771	0.801	$10,224
17	$ -	$12,771	-	$12,771	0.790	$10,083
18	$ -	$12,771	-	$12,771	0.779	$9,944
19	$ -	$12,771	-	$12,771	0.768	$9,806
20	$ -	$42,771	-	$42,771	0.757	$32,388
21	$ -	$12,771	-	$12,771	0.747	$9,537
22	$ -	$12,771	-	$12,771	0.736	$9,406
23	$ -	$12,771	-	$12,771	0.726	$9,276
24	$ -	$12,771	-	$12,771	0.716	$9,148
25	$ -	$42,771	-	$42,771	0.706	$30,213
26	$ -	$12,771	-	$12,771	0.697	$8,897
27	$ -	$12,771	-	$12,771	0.687	$8,774
28	$ -	$12,771	-	$12,771	0.678	$8,653
29	$ -	$12,771	-	$12,771	0.668	$8,533
30	$ -	$42,771	-	$42,771	0.659	$28,185
					Total Present Worth =	$24,032,400

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-5B - RCRA Cap, Limited Excavation and Offsite Disposal, In-situ Solvent Extraction, and Land Use Controls

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Planning Documents	1	LS	$25,000	$25,000
1.2	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.3	Pre-characterization Analysis (SVOCs, Metals, PCBs and a pesticide)	350	Each	$350	$122,500
1.4	Waste Characterization Analysis (RCRA)	15	Each	$900	$13,500
1.5	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$175,000**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities)	58	month	$3,000	$174,000
2.2	Utility Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	30	Month	$1,000	$30,000
2.5	Material staging area	46	Month	$1,000	$46,000
2.6	Heavy Equipment mob/demob	6	Each	$5,000	$30,000
2.7	Confirmation Sampling	81	Each	$405	$32,805
	Subtotal (Item 2)				**$357,805**

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3.	**Excavation, Disposal, and RCRA Cap**				
3a.	**Site 1**				
3.1	Site Clearing	1	Week	$10,000	$10,000
3.2	Demolition Settling Tank, Tops Cesspools	500	Tons	$160	$80,000
3.3	Soil Transport and Dispose, Hazardous	8,127	Tons	$480	$3,900,960
3.4	Soil Transport and Dispose, Non-hazardous	5,418	Tons	$160	$866,880
3.5	Equipment (Loader) (2)	7	Month	$3,200	$44,800
3.6	Equipment (Dozer/Compactor)	7	Month	$2,900	$20,300
3.7	Equipment (Excavator)	7	Month	$10,975	$76,825
3.8	Equipment (Truck)	7	Month	$3,200	$22,400
3.9	Labor - Operators (4)	28	Person-Month	$11,867	$332,276
3.10	Labor - Laborers (2)	14	Person-Month	$9,744	$136,416
3b.	**Site 1 RCRA Cap**				
3.11	2 Feet Compacted Clay	23,000	Tons	$62	$1,426,000
3.12	1 Foot Gravel	9,751	Tons	$44.15	$430,507
3.13	18 Inches Fill	16,389	Tons	$24.50	$401,531
3.14	6 Inches Top Soil	5,454	Tons	$22.50	$122,715
3.15	Geofabric	262,500	SF	$0.09	$23,625
3.16	80-mil HDPE geomembrane	87,500	SF	$1.32	$115,500
3.17	Equipment (Loader) (2)	14	Month	$3,200	$89,600
3.18	Equipment (Dozer/Compactor)	14	Month	$2,900	$40,600
3.19	Equipment (Excavator)	14	Month	$10,975	$153,650
3.20	Equipment (Truck)	14	Month	$3,200	$44,800
3.21	Labor- Operators (3)	42	Person-Month	$11,867	$498,414
3.22	Labor-Laborers (2)	28	Person-Month	$9,744	$272,832
3c.	**General**				
3.11	Misc Construction Supplies	21	Month	$500	$10,500
3.12	Fuel (2,000 gallons a month)	42,000	Gallons	$5	$210,000
3.13	Fuel Cube	21	Month	$575	$12,075
	Subtotal (Item 3)				**$9,343,205**

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	Tons	$24.50	$43,659
4b.	**General**				
4.3	Landscaping	1	LS	$20,000	$20,000
4.4	Material Staging Area Removal	1	Week	$18,000	$18,000
4.5	Decon of Equipment	6	Each	$5,000	$30,000
4.6	General Construction Debris Removal	4	Each	$5,000	$20,000
4.7	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.8	Establish Vegetation	16	Day	$200	$3,200
4.9	Water for Vegetation	1	LS	$1,000	$1,000
4.10	Materials for Watering Vegetation	1	LS	$5,000	$5,000
	Subtotal (Item 4)				**$159,164**
5	**Vertical Barrier**				
5.1	Mobilization	1	LS	$100,000	$100,000
5.2	Cement, Portland, Type I or II	9,200	Tons	$150	$1,380,000
5.3	Drilling, Grout Mixing, and Injection	30	Month	$100,000	$3,000,000
5.4	Spoil Containment, Collection, and Disposal	30	Month	$20,000	$600,000
	Subtotal (Item 5)				**$5,080,000**
6	**(Blower/Injection) Building Utilities**				
6.1	Building	800	SQ FT	$200	$160,000
6.2	Water Supply	1	Each	$20,000	$20,000
6.3	Sewer Connection	1	Each	$10,000	$10,000
6.4	Electricity Connection	1	Each	$50,000	$50,000
	Subtotal (Item 6)				**$240,000**

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

7	**Solvent Injection (Including 12 months O&M)**				
7a	**Site 1, Dry Well 20-08, and Dry Well 34-07**				
7.1	Injection and Air Sparge Wells (190 wells to 10 ft bgs plus 63 wells to 70 ft bgs)	6,310	FT	$50	$315,500
7.2	Solvent (Vertec)	1,200,000	Gallon	$6	$7,200,000
7b	**Dry Well 34-07**				
7.3	Injection and/or Air Sparge Wells (9 wells to 10 ft bgs plus 4 wells to 70 ft bgs)	370	FT	$50	$18,500
7.4	Solvent (Vertec)	20,000	Gallon	$6	$120,000
7c	**General**				
7.5	Mobilization	1	LS	$100,000	$100,000
7.6	Mixing Tanks, Pumps, Hoses, and Misc Equipment	1	LS	$240,000	$240,000
7.7	Operator	12	Person-Month	$11,867	$142,404
7.8	Operator	12	Person-Month	$9,744	$116,928
	Subtotal (Item 7)				**$8,253,332**
8	**Solvent/PCB Extraction (Including 6 months O&M)**				
8a	**Site 1 and Dry Well 20-08**				
8.1	Product Recovery Wells (20 wells to 60 ft bgs)	1,200	FT	$65	$78,000
8.2	Product Recovery Pumps	20	Each	$2,500	$50,000
8.3	Piping Misc	1	LS	$50,000	$50,000
8.4	Solvent/PCB Transportation and Recycle/Disposal	727,000	Gallon	$3	$2,181,000
8b	**Dry Well 34-07**				
8.5	Product Recovery Wells (1 well to 60 ft bgs)	60	FT	$65	$3,900
8.6	Product Recovery Pumps	1	Each	$2,500	$2,500
8.7	Piping Misc	1	LS	$15,000	$15,000
8.8	Solvent/PCB Transportation and Recycle/Disposal	13,000	Gallon	$3	$39,000
8c	**General**				
8.9	Raw/Waste Oil Tank (10,000 gal)	2	Each	$30,000	$60,000
8.10	Power and Controls	1	LS	$500,000	$500,000
8.11	Electrical	18	Month	$500	$9,000
8.12	Operator	6	Person-Month	$9,744	$58,464
8.13	Operator	6	Person-Month	$11,867	$71,202
	Subtotal (Item 8)				**$3,118,066**

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

9	**Air Sparge (construction only)**				
9.1	Blower	1	Each	$15,000	$15,000
9.2	Piping Misc	1	LS	$40,000	$40,000
9.3	Power and Controls	1	LS	$30,000	$30,000
9.4	Craft Labor (2)	0.2	Month	$9,744	$1,949
	Subtotal (Item 9)				**$86,949**
10	**Labor (Construction phase)**				
10.1	Construction Oversight (Supervisor)	52	Month	$23,100	$1,201,200
10.2	Construction Oversight (QA/QC & H&S)	52	Month	$19,900	$1,034,800
10.3	General Labor	26	Month	$19,900	$517,400
10.4	Office Support	70	Month	$19,900	$1,393,000
	Subtotal (Item 10)				**$4,146,400**
11.	**System Removal and Disposal**	1	Each	$500,000	**$500,000**
12.	**Construction Close Out Reporting**	1	LS	$60,000	**$60,000**
	Subtotal (Capital)				31,519,921
	Contingency (20%)				$6,303,984
	Design & Engineering (13%)				$4,097,590
	Total Construction Cost				**$41,921,495**

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

	Annual O&M Cost (S-5B)				
Item	**Description**	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**
13	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
14.	**Cap Maintenance**				
14.1	Miscellaneous Materials	13.5	Tons	$44.15	$596
14.2	Mowing	4.5	Acre	$1,000	$4,500
14.3	Fence Repair	50	Foot	$14.00	$700
14.4	Vegetation Repair	1	LS	$2,000	$2,000
14.5	Field Labor	5	Day	$995	$4,975
	Subtotal (Item 2)				**$12,771**
15.	**Air Sparge**				
16.1	Electrical	123,120	KW-Hrs	$0.22	$27,086
16.2	System Maintenance	1	LS	$5,000	$5,000
16.3	Operator (1/2 day per week)	26.0	days	$593	$15,427
	Subtotal (Item 4)				**$47,514**
16.	**O&M Reporting and Management**	1	Each	$50,000	**$50,000**

Cost Summary (without discount factor).

		Capital	O&M	Duration (year)	Total Cost
1	Delineation/Waste-Characterization	$175,000		1	$175,000
2	General Mobilization/Demobilization	$357,805		1	$357,805
3	Excavation, Disposal, and RCRA Cap	$9,343,205		1	$9,343,205
4	Site Restoration	$159,164		1	$159,164
5	Vertical Barrier	$5,080,000		1	$5,080,000
6	(Blower/Injection) Building Utilities	$240,000		1	$240,000
7	Solvent Injection (Including 12 months O&M)	$8,253,332		1	$8,253,332
8	Solvent/PCB Extraction (Including 6 months O&M)	$3,118,066		1	$3,118,066
9	Air Sparge (construction only)	$86,949		1	$86,949
10	Labor (Construction phase)	$4,146,400		1	$4,146,400
11	System Removal and Disposal	$500,000		1	$500,000
12	Construction Close Out Reporting	$60,000		1	$60,000
13	5-Year Review/LUCs		$30,000	6	$180,000
14	Cap Maintenance		$12,771	30	$383,131
15	Air Sparge		$47,514	5	$237,568
16	O&M Reporting and Management		$50,000	5	$250,000
	Total Alternative S-5B	$41,921,495	$140,285		

Alternative S-5B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

Dec-15		
As of	interest rate (OBM)	1.40%

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 41,921,495	0	$ -	$ 41,921,495	1	$41,921,495
1	$ -	$110,285	-	$110,285	0.986	$108,762
2	$ -	$110,285	-	$110,285	0.973	$107,260
3	$ -	$110,285	-	$110,285	0.959	$105,779
4	$ -	$110,285	-	$110,285	0.946	$132,696
5	$ -	$140,285	-	$140,285	0.933	$130,864
6	$ -	$12,771	-	$12,771	0.920	$11,749
7	$ -	$12,771	-	$12,771	0.907	$11,587
8	$ -	$12,771	-	$12,771	0.895	$11,427
9	$ -	$12,771	-	$12,771	0.882	$11,269
10	$ -	$42,771	-	$42,771	0.870	$37,219
11	$ -	$12,771	-	$12,771	0.858	$10,960
12	$ -	$12,771	-	$12,771	0.846	$10,809
13	$ -	$12,771	-	$12,771	0.835	$10,659
14	$ -	$12,771	-	$12,771	0.823	$10,512
15	$ -	$42,771	-	$42,771	0.812	$34,720
16	$ -	$12,771	-	$12,771	0.801	$10,224
17	$ -	$12,771	-	$12,771	0.790	$10,083
18	$ -	$12,771	-	$12,771	0.779	$9,944
19	$ -	$12,771	-	$12,771	0.768	$9,806
20	$ -	$12,771	-	$12,771	0.757	$9,671
21	$ -	$12,771	-	$12,771	0.747	$9,537
22	$ -	$12,771	-	$12,771	0.736	$9,406
23	$ -	$12,771	-	$12,771	0.726	$9,276
24	$ -	$12,771	-	$12,771	0.716	$9,148
25	$ -	$12,771	-	$12,771	0.706	$9,021
26	$ -	$12,771	-	$12,771	0.697	$8,897
27	$ -	$12,771	-	$12,771	0.687	$8,774
28	$ -	$12,771	-	$12,771	0.678	$8,653
29	$ -	$12,771	-	$12,771	0.668	$8,533
30	$ -	$42,771	-	$42,771	0.659	$28,185
					Total Present Worth =	$42,826,925

Alternative S-6
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-6 - Excavation and Offsite Disposal of PCB-Contaminated Soil (greater than 10 mg/kg)

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.2	Pre-characterization Analysis (SVOCs, Metals, PCBs and a pesticide)	324	Each	$350	$113,400
1.3	Waste Characterization Analysis (RCRA)	29	Each	$900	$26,100
1.4	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$153,500**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities)	42	month	$3,000	$126,000
2.2	Utiliy Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	42	Month	$1,000	$42,000
2.5	Material staging area	42	Month	$1,000	$42,000
2.6	Heavy Equipment mob/demob	6	Each	$5,000	$30,000
2.7	Confirmation Sampling	162	Each	$405	$65,610
	Subtotal (Item 2)				**$350,610**

Alternative S-6
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3.	**Excavation and Disposal**				
3a.	**Site 1 and Dry Well 20-08**				
3.1	Site Clearing	1	Week	$10,000	$10,000
3.2	Removal of Windrow	1	Week	$15,000	$15,000
3.3	Demolition Settling Tank, Tops Cesspools	1,800	Tons	$160	$288,000
3.4	Sheet Pile Drive and Equipment	40,620	CY	$75	$3,046,500
3.5	Excavation (soil and concrete) - Inhole & Lift	52	Month	$110,000	$5,720,000
3.6	Soil Transport, and Dispose, Hazardous	23,329	Tons	$480	$11,197,872
3.7	Soil Transport, and Dispose, Non-hazardous	84,316	Tons	$160	$13,490,576
3.8	De-Watering/Treatment and Discharge to Basins	1	LS	$200,000	$200,000
3.9	Backfill (off-site Source)	107,645	Tons	$24.50	$2,637,303
3.10	Equipment (Loader) (2)	40	Month	$3,200	$256,000
3.11	Equipment (Dozer/Compactor)	40	Month	$2,900	$116,000
3.12	Equipment (Excavator)	40	Month	$10,975	$439,000
3.13	Equipment (Truck)	40	Month	$3,200	$128,000
3.14	Labor- Operators (4)	160	Person-Month	$11,867	$1,898,720
3.15	Labor-Laborers (2)	80	Person-Month	$9,744	$779,520
3b.	**Dry-Well 34-07**				
3.16	Parking Lot Removal and Disposal (350 SQ FT)	1	week	$15,000	$15,000
3.17	Sheet Pile Drive and Equipment	102	CY	$75	$7,650
3.18	Excavation (soil and) - Inhole & Lift	1	Month	$110,000	$110,000
3.19	Soil Transport, and Dispose, Hazardous	360	Tons	$480	$172,800
3.20	Soil Transport, and Dispose, Non-hazardous	1,440	Tons	$160	$230,400
3.21	Backfill (off-site Source)	1,800	Tons	$24.50	$44,100
3.22	Equipment (Loader) (2)	2	Month	$3,200	$12,800
3.23	Equipment (Dozer/Compactor)	2	Month	$2,900	$5,800
3.24	Equipment (Excavator)	2	Month	$10,975	$21,950
3.25	Equipment (Truck)	2	Month	$3,200	$6,400
3.26	Labor- Operators (4)	8	Person-Month	$11,867	$94,936
3.27	Labor-Laborers (2)	4	Person-Month	$9,744	$38,976
3c.	**General**				
3.28	Misc Construction Supplies	42	Month	$500	$21,000
3.29	Fuel (2,000 gallons a month)	84,000	Gallons	$5	$420,000
3.30	Fuel Cube	42	Month	$575	$24,150
	Subtotal (Item 3)				**$41,448,453**

Alternative S-6
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	Tons	$24.50	$43,659
4c.	**Parking Lot Repair at Dry Well 34-07**				
4.3	Grading	1	LS	$15,000	$15,000
4.4	Crushed Concrete (delivered material)	350	SQ FT	$10	$3,500
4.5	Aphalt (material and install)	350	SQ FT	$15	$5,250
4b.	**General**				
4.6	Landscaping	1	LS	$20,000	$20,000
4.7	Material Staging Area Removal	1	Week	$18,000	$18,000
4.8	Decon of Equipment	6	Each	$5,000	$30,000
4.9	General Construction Debris Removal	4	Each	$5,000	$20,000
4.10	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.11	Establish Vegetation	16	Day	$200	$3,200
4.12	Water for Vegetation	1	LS	$1,000	$1,000
4.13	Materials for Watering Vegetation	1	LS	$5,000	$5,000
	Subtotal (Item 4)				**$182,914**
5	**Labor**				
5.1	Construction Oversight (Supervisor)	42	Month	$23,100	$970,200
5.2	Construction Oversight (QA/QC)	42	Month	$19,900	$835,800
5.3	Oversight (H&S, Supervisor)	21	Month	$19,900	$417,900
5.4	Office Support	42	Month	$19,900	$835,800
	Subtotal (Item 5)				**$3,059,700**
6.	**Construction Close Out Reporting**	1	LS	$50	**$50**
	Capital (Subtotal)				$45,195,227
	Contingency (20%)				$9,039,045
	Design & Engineering (13%)				$5,875,379
	Total Construction Cost				**$60,109,651**

Alternative S-6
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Annual O&M Cost (S-6)

Item	Description	Quantity	Units	Unit Cost	Extended Cost
7	**5-Year Review/LUCs**	1	Each	$30,000	**$30,000**
8	**Cover Maintenance**				
8.1	Gravel	13.5	Tons	$44.15	$596
8.2	Mowing	4.5	Acre	$1,000	$4,500
8.3	Fence Repair	50	Foot	$14.00	$700
8.4	Vegetation Repair	1	LS	$2,000	$2,000
8.5	Field Labor	5	Day	$995	$4,975
	Subtotal (Item 2)				**$12,771**

Cost Summary (without discount factor).

		Capital	O&M	Duration (year)	Total Cost
1	Delineation/Waste-Characterization	$153,500		1	$153,500
2	General Mobilization/Demobilization	$350,610		1	$350,610
3	Excavation and Disposal	$41,448,453		1	$41,448,453
4	Site Restoration	$182,914		1	$182,914
5	Labor	$3,059,700		1	$3,059,700
6	Construction Close Out Reporting	$50		1	$50
7	5-Year Review/LUCs		$30,000	6	$180,000
8	Cover Maintenance		$12,771	30	$383,131
	Total Alternative S-6	$60,109,651	$42,771		

Alternative S-6
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

		Capital	As of Dec-15 Annual Cost	interest rate (OBM) Additional Year Cost	1.40% Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$	60,109,651	0	$ -	$ 60,109,651	1	$60,109,651
1	$	-	$12,771	-	$12,771	0.986	$12,595
2	$	-	$12,771	-	$12,771	0.973	$12,421
3	$	-	$12,771	-	$12,771	0.959	$12,249
4	$	-	$12,771	-	$12,771	0.946	$12,080
5	$	-	$42,771	-	$42,771	0.933	$39,899
6	$	-	$12,771	-	$12,771	0.920	$11,749
7	$	-	$12,771	-	$12,771	0.907	$11,587
8	$	-	$12,771	-	$12,771	0.895	$11,427
9	$	-	$12,771	-	$12,771	0.882	$11,269
10	$	-	$42,771	-	$42,771	0.870	$37,219
11	$	-	$12,771	-	$12,771	0.858	$10,960
12	$	-	$12,771	-	$12,771	0.846	$10,809
13	$	-	$12,771	-	$12,771	0.835	$10,659
14	$	-	$12,771	-	$12,771	0.823	$10,512
15	$	-	$42,771	-	$42,771	0.812	$34,720
16	$	-	$12,771	-	$12,771	0.801	$10,224
17	$	-	$12,771	-	$12,771	0.790	$10,083
18	$	-	$12,771	-	$12,771	0.779	$9,944
19	$	-	$12,771	-	$12,771	0.768	$9,806
20	$	-	$42,771	-	$42,771	0.757	$32,388
21	$	-	$12,771	-	$12,771	0.747	$9,537
22	$	-	$12,771	-	$12,771	0.736	$9,406
23	$	-	$12,771	-	$12,771	0.726	$9,276
24	$	-	$12,771	-	$12,771	0.716	$9,148
25	$	-	$42,771	-	$42,771	0.706	$30,213
26	$	-	$12,771	-	$12,771	0.697	$8,897
27	$	-	$12,771	-	$12,771	0.687	$8,774
28	$	-	$12,771	-	$12,771	0.678	$8,653
29	$	-	$12,771	-	$12,771	0.668	$8,533
30	$	-	$42,771	-	$42,771	0.659	$28,185
						Total Present Worth =	$60,562,873

Alternative S-7
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative S-7 - Excavation and Offsite Disposal of PCB-Contaminated Soil (greater than 1 mg/kg)

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Delineation/Waste-Characterization**				
1.1	Drilling Mob and Demob	1	LS	$6,000	$6,000
1.2	Pre-characterization Analysis (SVOCs, Metals, PCBs and a pesticide)	324	Each	$350	$113,400
1.3	Waste Characterization Analysis (RCRA)	29	Each	$900	$26,100
1.4	SVE and Monitoring Well Protection	16	Each	$500	$8,000
	Subtotal (Item 1)				**$153,500**
2.	**General Mobilization/Demobilization**				
2.1	Construction Facilities (trailer, utilities)	75	month	$3,000	$225,000
2.2	Utiliy Clearance	1	LS	$15,000	$15,000
2.3	Site Prep (high vis fence, traffic control, E&S controls)	1	LS	$30,000	$30,000
2.4	Portable Scale	75	Month	$1,000	$75,000
2.5	Material staging area	75	Month	$1,000	$75,000
2.6	Heavy Equipment mob/demob	6	Each	$5,000	$30,000
2.7	Confirmation Sampling	288	Each	$405	$116,640
	Subtotal (Item 2)				**$450,000**

Alternative S-7
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

3.	**Excavation and Disposal**				
3a.	**Site 1 and Dry Well 20-08**				
3.1	Site Clearing	1	Week	$10,000	$10,000
3.2	Removal of Windrow	1	Week	$15,000	$15,000
3.3	Demoltion of Settling Tank, Tops Cesspools	1,800	Tons	$160	$288,000
3.4	Sheet Pile Drive and Equipment	48,744	CY	$75	$3,655,800
3.5	Excavation (soil and concrete) - Inhole & Lift	100	Month	$110,000	$11,000,000
3.6	Soil Transport, and Dispose, Hazardous	23,329	Tons	$480	$11,197,872
3.7	Soil Transport, and Dispose, Non-Hazardous	190,871	Tons	$160	$30,539,376
3.8	De-Watering/Treatment and Discharge to Basins	1.5	Month	$25,000	$37,500
3.9	Backfill (off-site Source)	214,200	Tons	$24.50	$5,247,900
3.10	Equipment (Loader) (2)	73	Month	$3,200	$467,200
3.11	Equipment (Dozer/Compactor)	73	Month	$2,900	$211,700
3.12	Equipment (Excavator)	73	Month	$10,975	$801,175
3.13	Equipment (Truck)	73	Month	$3,200	$233,600
3.14	Labor- Operators (4)	292	Person-Month	$11,867	$3,465,164
3.15	Labor-Laborers (2)	146	Person-Month	$9,744	$1,422,624
3b.	**Dry-Well 34-07**				
3.16	Parking Lot Removal and Disposal (350 SQ FT)	1	week	$15,000	$15,000
3.17	Sheet Pile Drive and Equipment	102	CY	$75	$7,650
3.18	Excavation (soil and) - Inhole & Lift	1	Month	$110,000	$110,000
3.19	Soil Transport, and Dispose, Hazardous	360	Tons	$480	$172,800
3.20	Soil Transport, and Dispose, Non-hazardous	1,440	Tons	$160	$230,400
3.21	Backfill (off-site Source)	1,800	Tons	$24.50	$44,100
3.22	Equipment (Loader) (2)	2	Month	$3,200	$12,800
3.23	Equipment (Dozer/Compactor)	2	Month	$2,900	$5,800
3.24	Equipment (Excavator)	2	Month	$10,975	$21,950
3.25	Equipment (Truck)	2	Month	$3,200	$6,400
3.26	Labor- Operators (4)	8	Person-Month	$11,867	$94,936
3.27	Labor-Laborers (2)	4	Person-Month	$9,744	$38,976
3c.	**General**				
3.28	Misc Construction Supplies	75	Month	$500	$37,500
3.29	Fuel (2,000 gallons a month)	150,000	Gallons	$5	$750,000
3.30	Fuel Cube	75	Month	$575	$43,125
	Subtotal (Item 3)				**$70,141,223**

Alternative S-7
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

4.	**Site Restoration**				
4a.	**Windrow at Site 1**				
4.1	Top Soil (off-site Source) (6 inches)	378.0	Tons	$22.50	$8,505
4.2	Fill Material (4.5' high mound, 23' wide, 450' long)	1,782	CU YDs	$24.50	$43,659
4c.	**Parking Lot Repair at Dry Well 34-07**				
4.3	Grading	1	LS	$15,000	$15,000
4.4	Crushed Concrete (delivered material)	350	SQ FT	$10	$3,500
4.5	Aphalt (material and install)	350	SQ FT	$15	$5,250
4d.	**General**				
4.6	Landscaping	1	LS	$20,000	$20,000
4.7	Material Staging Area Removal	1	Week	$18,000	$18,000
4.8	Decon of Equipment	6	Each	$5,000	$30,000
4.9	General Construction Debris Removal	4	Each	$5,000	$20,000
4.10	Re-install Fence, Eastern Edge	700	Foot	$14.00	$9,800
4.11	Establish Vegetation	16	Day	$200	$3,200
4.12	Water for Vegetation	1	LS	$1,000	$1,000
4.13	Materials for Watering Vegetation	1	LS	$5,000	$5,000
4.14	Post Construction Repairs	2	Year	$5,000	$10,000
	Subtotal (Item 4)				**$192,914**
5.	**Labor**				
5.1	Construction Oversight (Supervisor)	75	Month	$23,100	$1,732,500
5.2	Construction Oversight (QA/QC)	75	Month	$19,900	$1,492,500
5.3	Oversight (H&S, Supervisor)	38	Month	$19,900	$756,200
5.4	General Labor	75	Month	$19,900	$1,492,500
	Subtotal (Item 7)				**$3,981,200**
6.	**Construction Close Out Reporting**	1	LS	$30,000	**$30,000**
	Capital Subtotal				$74,948,837
	Contingency (20%)				$14,989,767
	Design & Engineering (13%)				$9,743,349
	Total Construction Cost				**$99,681,953**

Alternative SV-1
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative SV-1 - No Action

Capital Cost:	$0
O&M:	$0
NPV:	$0

Alternative SV-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative SV-2 - Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System

Annual O&M Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**5-Year Review/LUCs (incremental to the soil remedy)**	1	Each	$15,000	**$15,000**
2.	**Air Sampling, analysis and reporting**				
2.1	Regulatory Compliance (VOCs) - 3 Per Month	36	Each	$320	$11,520
2.2	Pressure Readings SVPMs (Piezometers)	18	Each	$0	$0
2.3	SVPM (Piezometer) Sampling - VOCs - Yearly	22	Each	$320	$7,040
2.4	SVE Well Sampling - 12 Wells - VOCs - Yearly	14	Each	$320	$4,480
2.5	Operator (one day per week)	52	Week	$995	$21,340
2.6	Annual Reporting	1	Each	$50,000	$50,000
	Subtotal (Item 2)				**$94,380**

Cost Summary (without discount factor).

		Capital	O&M
1.	5-Year Review/LUCs (incremental to the soil remedy)		$15,000
2.	Air Sampling, analysis and reporting		$94,380
3.	Telemetry		$2,400
4.	Electricity		$5,583
	Total		$102,363

Alternative SV-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ -	0	$ -	$ -	1	$0
1	$ -	$102,363	-	$102,363	0.986	$100,950
2	$ -	$102,363	-	$102,363	0.973	$99,556
3	$ -	$102,363	-	$102,363	0.959	$98,181
4	$ -	$102,363	-	$102,363	0.946	$96,826
5	$ -	$102,363	15,000	$117,363	0.933	$109,482
6	$ -	$102,363	-	$102,363	0.920	$94,171
7	$ -	$102,363	-	$102,363	0.907	$92,870
8	$ -	$102,363	-	$102,363	0.895	$91,588
9	$ -	$102,363	-	$102,363	0.882	$90,324
10	$ -	$102,363	15,000	$117,363	0.870	$102,130
11	$ -	$102,363	-	$102,363	0.858	$87,847
12	$ -	$102,363	-	$102,363	0.846	$86,634
13	$ -	$102,363	-	$102,363	0.835	$85,438
14	$ -	$102,363	-	$102,363	0.823	$84,258
15	$ -	$102,363	15,000	$117,363	0.812	$95,271
16	$ -	$102,363	-	$102,363	0.801	$81,948
17	$ -	$102,363	-	$102,363	0.790	$80,816
18	$ -	$102,363	-	$102,363	0.779	$79,700
19	$ -	$102,363	-	$102,363	0.768	$78,600
20	$ -	$102,363	15,000	$117,363	0.757	$88,873
21	$ -	$102,363	-	$102,363	0.747	$76,444
22	$ -	$102,363	-	$102,363	0.736	$75,389
23	$ -	$102,363	-	$102,363	0.726	$74,348
24	$ -	$102,363	-	$102,363	0.716	$73,322
25	$ -	$102,363	15,000	$117,363	0.706	$82,905
26	$ -	$102,363	-	$102,363	0.697	$71,311
27	$ -	$102,363	-	$102,363	0.687	$70,326
28	$ -	$102,363	-	$102,363	0.678	$69,355
29	$ -	$102,363	-	$102,363	0.668	$68,398
30	$ -	$102,363	15,000	$117,363	0.659	$77,338
					Total Present Worth =	$2,564,599

Alternative SV-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative SV-3 - Soil Vapor Monitoring, Land Use Controls, Continued Operation of the SVE Containment System and Additional Extraction Wells

Capital Cost

1.	**SVEC System Add-On**				
1.1	Planning Documents/Design	1	LS	$35,000	$35,000
1.2	Mobilization	1	LS	$10,000	$10,000
1.3	SVEC Wells (6 at 50 feet)	300	FT	$65	$19,500
1.4	Piping Misc	1	LS	$35,000	$35,000
1.5	Power and Controls	1	LS	$25,000	$25,000
1.6	Blower	1	Each	$8,000	$8,000
1.7	IDW Management	1	LS	$7,500	$7,500
1.5	Labor	2.0	Month	$9,744	$19,488
1.6	Construction Oversight (Supervisor,QC/geologist)	2.0	Month	$11,550	$23,100
	Subtotal (Item 1)				$182,588
	Contingency (20%)				$36,518
	Total Capital				**$219,106**

Annual O&M Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
2.	**5-Year Review/LUCs (incremental to the soil remedy)**	1	Each	$15,000	**$15,000**
2.	**Air Sampling, analysis and reporting**				
2.1	Regulatory Compliance (VOCs) - 3 Per Month	36	Each	$320	$11,520
2.2	Pressure Readings SVPMs (Piezometers)	18	Each	$0	$0
2.3	SVPM (Piezometer) Sampling - VOCs - Yearly	22	Each	$320	$7,040
2.4	SVE Well Sampling - 18 Wells - VOCs - Yearly	22	Each	$320	$7,040
2.5	Operator (one day per week)	52	Week	$995	$21,340
2.6	Annual Reporting	1	Each	$50,000	$50,000
	Subtotal (Item 2)				**$96,940**

Cost Summary (without discount factor).

		Capital	O&M
1.	SVEC System Add-On	$219,106	
2.	5-Year Review/LUCs (incremental to the soil remedy)		$15,000
3.	Air Sampling, analysis and reporting		$96,940
4.	Electricity		$11,166
5.	Telemetry		$2,400
	Subtotal	$219,106	$110,506

Alternative SV-3
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 219,106	0	$ -	$ 219,106	1	$219,106
1	$ -	$110,506	-	$110,506	0.986	$108,980
2	$ -	$110,506	-	$110,506	0.973	$107,476
3	$ -	$110,506	-	$110,506	0.959	$105,992
4	$ -	$110,506	-	$110,506	0.946	$104,528
5	$ -	$110,506	15,000	$125,506	0.933	$117,078
6	$ -	$110,506	-	$110,506	0.920	$101,662
7	$ -	$110,506	-	$110,506	0.907	$100,258
8	$ -	$110,506	-	$110,506	0.895	$98,874
9	$ -	$110,506	-	$110,506	0.882	$97,509
10	$ -	$110,506	15,000	$125,506	0.870	$109,216
11	$ -	$110,506	-	$110,506	0.858	$94,835
12	$ -	$110,506	-	$110,506	0.846	$93,526
13	$ -	$110,506	-	$110,506	0.835	$92,234
14	$ -	$110,506	-	$110,506	0.823	$90,961
15	$ -	$110,506	15,000	$125,506	0.812	$101,881
					Total Present Worth =	$1,744,115

Alternative G-1
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative G-1 - No Action

Capital Cost:	$0
O&M:	$0
NPV:	$0

Alternative G-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative G-2 - Annual Monitoring and Installation of Additional Wells

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Baseline GW Sampling, analysis and reporting**				
1.1	Laboratory Analysis (VOCs)	41	Each	$120	$4,920
1.2	Laboratory Analysis (PCBs)	36	Each	$100	$3,600
1.3	Laboratory Analysis (Chromium)	36	Each	$70	$2,520
1.4	Field Labor (1)	10	Day	$1,200	$12,000
1.5	UPF-SAP/Work Plan for long term monitoring	1	Each	$30,000	$30,000
1.6	Reporting	1	Each	$40,000	$40,000
	Subtotal (Item 1)				**$93,040**
2.	**Install 4 Wells**				
2.1	Install 4 Wells (3 Intermediate, 1 Deep)	900	Foot	$100	**$90,000**
2.2	Geologist	20	Day	$1,200	**$24,000**
2.3	Drilling Mob/Demob	1	Each	$6,000	**$6,000**
2.4	Reporting	1	Each	$15,000	**$15,000**
	Subtotal (Item 2)				**$135,000**

Annual O&M Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
3.	**5-Year Review/LUCs (incremental to the soil remedy)**	1	Each	$15,000	**$15,000**
4.	**GW Sampling, Analysis, and Reporting**				
4.1	Laboratory Analysis (VOCs)	41	Each	$120	$4,920
4.2	Laboratory Analysis (PCBs)	36	Each	$100	$3,600
4.3	Laboratory Analysis (Chromium)	36	Each	$70	$2,520
4.4	Field Labor	10	Day	$1,200	$12,000
4.5	Annual Reporting and Validation	1	Each	$15,000	$15,000
4.6	Contingency (20%)				$7,608
	Subtotal (Item 2)				**$45,648**
5.	**O&M Reporting and Management**	1	Each	$50,000	**$50,000**

Cost Summary (without discount factor).

		Capital	O&M
1	Sampling and Well Install	$228,040	
2	5-Year Review/LUCs (incremental to the soil remedy)		$15,000
3	GW Sampling, Analysis, and Reporting		$45,648
4	O&M Reporting and Management		$50,000
	Total		$95,648

Alternative G-2
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Present Value Calculation

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 228,040	0	$ -	$ 228,040	1	$228,040
1	$ -	$95,648	-	$95,648	0.986	$94,327
2	$ -	$95,648	-	$95,648	0.973	$93,025
3	$ -	$95,648	-	$95,648	0.959	$91,741
4	$ -	$95,648	-	$95,648	0.946	$90,474
5	$ -	$95,648	15,000	$110,648	0.933	$103,218
6	$ -	$95,648	-	$95,648	0.920	$87,993
7	$ -	$95,648	-	$95,648	0.907	$86,778
8	$ -	$95,648	-	$95,648	0.895	$85,580
9	$ -	$95,648	-	$95,648	0.882	$84,398
10	$ -	$95,648	15,000	$110,648	0.870	$96,286
11	$ -	$95,648	-	$95,648	0.858	$82,084
12	$ -	$95,648	-	$95,648	0.846	$80,951
13	$ -	$95,648	-	$95,648	0.835	$79,833
14	$ -	$95,648	-	$95,648	0.823	$78,731
15	$ -	$95,648	15,000	$110,648	0.812	$89,820
16	$ -	$95,648	-	$95,648	0.801	$76,572
17	$ -	$95,648	-	$95,648	0.790	$75,515
18	$ -	$95,648	-	$95,648	0.779	$74,472
19	$ -	$95,648	-	$95,648	0.768	$73,444
20	$ -	$95,648	15,000	$110,648	0.757	$83,789
21	$ -	$95,648	-	$95,648	0.747	$71,430
22	$ -	$95,648	-	$95,648	0.736	$70,443
23	$ -	$95,648	-	$95,648	0.726	$69,471
24	$ -	$95,648	-	$95,648	0.716	$68,512
25	$ -	$95,648	15,000	$110,648	0.706	$78,162
26	$ -	$95,648	-	$95,648	0.697	$66,633
27	$ -	$95,648	-	$95,648	0.687	$65,713
28	$ -	$95,648	-	$95,648	0.678	$64,806
29	$ -	$95,648	-	$95,648	0.668	$63,911
30	$ -	$95,648	15,000	$110,648	0.659	$72,913
					Total Present Worth =	$2,629,063

Alternative G-3A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative G-3A - GAC Add-On and Annual Monitoring

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Baseline GW Sampling, analysis and reporting**				
1.1	Laboratory Analysis (VOCs)	41	Each	$120	$4,920
1.2	Laboratory Analysis (PCBs)	36	Each	$100	$3,600
1.3	Laboratory Analysis (Chromium)	36	Each	$70	$2,520
1.4	Field Labor (1)	10	Day	$1,200	$12,000
1.5	UPF-SAP/Work Plan for long term monitoring	1	Each	$30,000	$30,000
1.6	Reporting	1	Each	$40,000	$40,000
	Subtotal (Item 1)				**$93,040**
2.	**Install 4 Wells**				
2.1	Install 4 Wells (3 Intermediate, 1 Deep)	900	Foot	$100	**$90,000**
2.2	Geologist	20	Day	$1,200	**$24,000**
2.3	Drilling Mob/Demob	1	Each	$6,000	**$6,000**
2.4	Reporting	1	Each	$6,000	**$6,000**
	Subtotal (Item 2)				**$126,000**
3.	**PCB Treatment Add-On (ONCT)**				
3.1	Granular Activated Carbon - 20,000 Pound Unit	6	Unit	$350,000	$2,100,000
3.2	Installation	6	LS	$125,000	$750,000
	Subtotal (Item 2)				**$2,850,000**
	Annual O&M Cost				
Item	**Description**	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**
4	**5-Year Review/LUCs (incremental to the soil remedy)**	1	Each	$15,000	**$15,000**
5.	**GW Sampling, Analysis, and Reporting**				
5.1	Laboratory Analysis (VOCs)	41	Each	$120	$4,920
5.2	Laboratory Analysis (PCBs)	36	Each	$100	$3,600
5.3	Laboratory Analysis (Chromium)	36	Each	$70	$2,520
5.4	Field Labor (2)	10	Day	$1,200	$12,000
5.5	Annual Reporting and Validation	1	Each	$15,000	$15,000
5.6	Contingency (20%)				$7,608
	Subtotal (Item 5)				**$45,648**
6	**O&M Reporting and Management**				
6.1	Laboratory Analysis (PCBs)	32	Each	$100	$3,200
6.2	Carbon Changeout	2700	lbs	$3	$8,100
6.3	O&M Labor	26	days	$1,200	$31,200
6.4	Reporting	12	months	$1,500	$18,000
6.5	Incremental Power	170450	Kw-hr	$0.1723	$29,369
6.6	Contingency (20%)				$17,974
	Subtotal (Item 6)				**$107,842**

Alternative G-3A
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Cost Summary (without discount factor).

		Capital	O&M
1	Alternative G-3A - GAC Add-On and Annual Monitoring	$93,040	
2	Install 4 Wells	$126,000	
3	PCB Treatment Add-On (ONCT)	$2,850,000	
4	5-Year Review/LUCs (incremental to the soil remedy)		$15,000
5	GW Sampling, Analysis, and Reporting		$45,648
6	O&M Reporting and Management		$107,842
	Total (Alternative G-3A)	$3,069,040	$153,490

Present Value Calculation

	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 3,069,040	0	$ -	$ 3,069,040	1	$3,069,040
1	$ -	$153,490	-	$153,490	0.986	$151,371
2	$ -	$153,490	-	$153,490	0.973	$149,281
3	$ -	$153,490	-	$153,490	0.959	$147,220
4	$ -	$153,490	-	$153,490	0.946	$145,187
5	$ -	$153,490	15,000	$168,490	0.933	$157,176
6	$ -	$153,490	-	$153,490	0.920	$141,206
7	$ -	$153,490	-	$153,490	0.907	$139,256
8	$ -	$153,490	-	$153,490	0.895	$137,334
9	$ -	$153,490	-	$153,490	0.882	$135,438
10	$ -	$153,490	15,000	$168,490	0.870	$146,621
11	$ -	$153,490	-	$153,490	0.858	$131,724
12	$ -	$153,490	-	$153,490	0.846	$129,905
13	$ -	$153,490	-	$153,490	0.835	$128,111
14	$ -	$153,490	-	$153,490	0.823	$126,342
15	$ -	$153,490	15,000	$168,490	0.812	$136,775
16	$ -	$153,490	-	$153,490	0.801	$122,878
17	$ -	$153,490	-	$153,490	0.790	$121,181
18	$ -	$153,490	-	$153,490	0.779	$119,508
19	$ -	$153,490	-	$153,490	0.768	$117,858
20	$ -	$153,490	15,000	$168,490	0.757	$127,590
21	$ -	$153,490	-	$153,490	0.747	$114,626
22	$ -	$153,490	-	$153,490	0.736	$113,044
23	$ -	$153,490	-	$153,490	0.726	$111,483
24	$ -	$153,490	-	$153,490	0.716	$109,944
25	$ -	$153,490	15,000	$168,490	0.706	$119,022
26	$ -	$153,490	-	$153,490	0.697	$106,929
27	$ -	$153,490	-	$153,490	0.687	$105,452
28	$ -	$153,490	-	$153,490	0.678	$103,996
29	$ -	$153,490	-	$153,490	0.668	$102,560
30	$ -	$153,490	15,000	$168,490	0.659	$111,029
					Total Present Worth =	$6,879,086

Alternative G-3B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

Alternative G-3B - Hexavalent Chromium Add-On and Annual Monitoring

Capital Cost

Item	Description	Quantity	Units	Unit Cost	Extended Cost
1.	**Baseline GW Sampling, analysis and reporting**				
1.1	Laboratory Analysis (VOCs, PCBs, and Chromium)	41	Each	$120	$4,920
1.2	Laboratory Analysis (PCBs)	36	Each	$100	$3,600
1.3	Laboratory Analysis (Chromium)	36	Each	$70	$2,520
1.4	Field Labor (2)	10	Day	$1,200	$12,000
1.5	UPF-SAP/Work Plan for long term monitoring	1	Each	$30,000	$30,000
1.6	Reporting	1	Each	$40,000	$40,000
	Subtotal (Item 1)				**$93,040**
2.	**Install 4 Wells**				
2.1	Install 4 Wells (3 Intermediate, 1 Deep)	900	Foot	$100	**$90,000**
2.2	Geologist	20	Day	$1,200	**$24,000**
2.3	Drilling Mob/Demob	1	Each	$6,000	**$6,000**
2.4	Decon Pad	1	Each	$6,000	**$6,000**
	Subtotal (Item 2)				**$126,000**
3.	**Hexavalent Chromium Treatment Add-On (ONCT)**				
3.1	Ion Exchange Resin	2	Unit	$551,500	$1,103,000
3.2	Installation	2	LS	$300,000	$600,000
3.3	Support Equipment	2	LS	$150,000	$300,000
	Subtotal (Item 3)				**$2,003,000**
	Annual O&M Cost				
Item	**Description**	**Quantity**	**Units**	**Unit Cost**	**Extended Cost**
4.	**5-Year Review/LUCs**	1	Each	$15,000	**$15,000**
5.	**GW Sampling, Analysis, and Reporting**				
5.1	Laboratory Analysis (VOCs, PCBs, and Chromium)	41	Each	$120	$4,920
5.2	Laboratory Analysis (PCBs)	36	Each	$100	$3,600
5.3	Laboratory Analysis (Chromium)	36	Each	$70	$2,520
5.4	Field Labor	10	Day	$1,200	$12,000
5.5	Annual Reporting and Validation	1	Each	$40,000	$40,000
5.6	Contingency (20%)				$12,608
	Subtotal (Item 5)				**$75,648**
6	**O&M Reporting and Management**				
6.1	Laboratory Analysis (chromium)	32	Each	$70	$2,240
6.2	Resin changeout	40000	lbs	$7	$280,000
6.3	O&M Labor	52	days	$1,200	$62,400
6.4	Reporting	12	months	$1,500	$18,000
6.5	Regeneration	365	days	$100	$36,500
6.6	Contingency (20%)				$79,828
	Subtotal (Item 6)				**$478,968**

Cost Summary (without discount factor).

		Capital	O&M

Alternative G-3B
Site 1 - Former Drum Marshalling Area
NWIRP Bethpage, New York

1	Baseline GW Sampling, analysis and reporting	$93,040	
2	Install 4 Wells	$126,000	
3	Hexavalent Chromium Treatment Add-On (ONCT)	$2,003,000	
4	5-Year Review/LUCs		$15,000
5	GW Sampling, Analysis, and Reporting		$75,648
6	Subtotal (Item 6)		$478,968
	Total	$2,222,040	$554,616

Present Value Calculation	Capital	Annual Cost	Additional Year Cost	Total Year Cost	Annual Discount Rate - 1.4%	NPW
0	$ 2,222,040	0	$ -	$ 2,222,040	1	$2,222,040
1	$ -	$554,616	-	$554,616	0.986	$546,959
2	$ -	$554,616	-	$554,616	0.973	$539,407
3	$ -	$554,616	-	$554,616	0.959	$531,959
4	$ -	$554,616	-	$554,616	0.946	$524,615
5	$ -	$554,616	15,000	$569,616	0.933	$531,364
6	$ -	$554,616	-	$554,616	0.920	$510,228
7	$ -	$554,616	-	$554,616	0.907	$503,184
8	$ -	$554,616	-	$554,616	0.895	$496,237
9	$ -	$554,616	-	$554,616	0.882	$489,385
10	$ -	$554,616	15,000	$569,616	0.870	$495,681
11	$ -	$554,616	-	$554,616	0.858	$475,965
12	$ -	$554,616	-	$554,616	0.846	$469,393
13	$ -	$554,616	-	$554,616	0.835	$462,913
14	$ -	$554,616	-	$554,616	0.823	$456,521
15	$ -	$554,616	15,000	$569,616	0.812	$462,395
16	$ -	$554,616	-	$554,616	0.801	$444,002
17	$ -	$554,616	-	$554,616	0.790	$437,872
18	$ -	$554,616	-	$554,616	0.779	$431,826
19	$ -	$554,616	-	$554,616	0.768	$425,864
20	$ -	$554,616	15,000	$569,616	0.757	$431,343
21	$ -	$554,616	-	$554,616	0.747	$414,186
22	$ -	$554,616	-	$554,616	0.736	$408,467
23	$ -	$554,616	-	$554,616	0.726	$402,828
24	$ -	$554,616	-	$554,616	0.716	$397,266
25	$ -	$554,616	15,000	$569,616	0.706	$402,377
26	$ -	$554,616	-	$554,616	0.697	$386,372
27	$ -	$554,616	-	$554,616	0.687	$381,037
28	$ -	$554,616	-	$554,616	0.678	$375,777
29	$ -	$554,616	-	$554,616	0.668	$370,588
30	$ -	$554,616	15,000	$569,616	0.659	$375,356
					Total Present Worth =	$15,803,409

APPENDIX D

ENVIRONMENTAL FOOTPRINT

APPENDIX D

Environmental Footprint Evaluation
Site 1 – Former Drum Marshalling Area
NWIRP Bethpage, New York
September 2015

OBJECTIVE

This Environmental Footprint Evaluation of remedial alternatives is provided as Appendix D to the Feasibility Study (FS) for Site 1 located at the former Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage in Bethpage, NY. The purpose of the footprint evaluation is to assess the environmental impacts of twelve remedial alternatives (in addition to the no action alternative) using the metrics of greenhouse gas (GHG) and criteria pollutant emissions, energy use, water consumption, and worker safety. The results of this footprint evaluation are intended to provide additional information for consideration during remedy selection, design, and to enhance the understanding of the environmental impacts throughout the remedy life-cycle for each of the proposed alternatives.

POLICY BACKGROUND

Department of Defense (DOD) and Navy policies require continual optimization of remedies in every phase from remedy selection through site closeout (NAVFAC, 2010a).

In January 2007, Executive Order 13423 set targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, etc. In October 2009, Executive Order 13514 was issued, which reinforced these sustainability requirements and established specific goals for federal agencies to meet by 2020.

In August 2009, DOD issued a policy for "Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program." The DOD policy and related Navy guidance state that opportunities to increase sustainability should be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout). In response to this policy, the Department of the Navy (DON) issued an updated Navy Guidance for "Optimizing Remedy Evaluation, Selection, and Design" (NAVFAC, 2010), which includes environmental footprint evaluations as part of the traditional DON optimization review process for remedy selection, design, and remedial action operation. In August 2010, the Naval Facilities Engineering Command (NAVFAC) issued policy requiring use of the SiteWise™ tool to perform environmental impact reviews as part of all Feasibility Studies and Remedial Action Plans. As such, this environmental footprint evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of reducing the environmental impact of remedial action at NWIRP Bethpage.

Applying the DON optimization concepts with an environmental footprint evaluation within the remedy selection and design phases allows for the following benefits:

- Determining factors in each remedial alternative with the greatest environmental impacts and gathering insight into how to reduce these impacts;
- Evaluating remedial alternatives with optimized or reduced environmental footprints in conjunction with other selection criteria;
- Designing and implementing a more robust remedy while balancing the impact to the environment; and
- Ensuring efficient, cost-effective and sustainable site closeout.

EVALUATION TOOLS

This evaluation was performed using a hybrid model of the Navy's SiteWise™ tool supplemented with a Tetra Tech developed model (GSR_X) as appropriate for some site-specific items.

SiteWise™ is a life-cycle footprint assessment tool developed jointly by the U.S. Navy, U.S. Army Corps of Engineers (USACE), and Battelle. SiteWise™ assesses the environmental footprint of a remedial alternative/technology using a consistent set of metrics. The assessment is conducted using a building block approach, where each remedial alternative is first broken down into modules that follow the phases for most remedial actions, including remedial investigation (RI), remedial action construction (RA-C), remedial action operation (RA-O), and long-term monitoring (LTM). Once broken down by remedial phase, the footprint of each phase is calculated. The phase-specific footprints are then combined to estimate the overall footprint of the remedial alternative. This building block approach reduces redundancy in the footprint assessment and facilitates the identification of specific impact drivers that contribute to the environmental footprint. The inputs that need to be considered include (1) production of material required by the activity; (2) transportation of the required materials to the site, transportation of personnel; (3) all site activities to be performed; and (4) management of the waste produced by the activity.

GSRx builds off of SiteWise™ and allows for a flexible, detailed analysis, particularly for materials and equipment use. GSRx was used to account for materials and activities not readily input into SiteWise™ and where equipment usage assumptions built into SiteWise™ were not consistent with site-specific requirements.

ENVIRONMENTAL FOOTPRINT EVALUATION FRAMEWORK AND LIMITATIONS

The environmental footprint evaluation performed for the Site 1 FS considered life-cycle impacts through greenhouse gas emissions (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]), criteria air pollutant emissions (through sulfur oxides [SO_X] and particulate matter [PM_{10} emissions]), energy consumption, water usage, and worker safety.

Life cycle inventory inputs in SiteWise™ were divided into four categories – 1) materials production; 2) transportation of personnel, materials and equipment; 3) equipment use and miscellaneous; and 4) residual handling and disposal. Cost estimates from the FS and design calculations were used as a basis for inventory quantities and related assumptions. Emission factors, energy consumption, and water usage data were correlated to material quantities, equipment, transportation distances, and installation time frames in order to calculate life-cycle emissions, energy consumption, water usage, and worker safety. Default SiteWise™ emission, energy usage, water consumption, and worker fatality and accident risk factors were utilized.

Although a hybrid model of GSRx and Sitewise™ was used to streamline inputs within SiteWise™, limitations still exist. For example, materials and usage of construction equipment are included in the input inventory in GSRx to directly evaluate impact drivers within the GSRx output summary, but are evaluated within the "Equipment Use and Miscellaneous" Sector in SiteWise™ which does not differentiate between specific materials or equipment. Additionally, GSRx does not include worker safety based on specific equipment usage because GSRx was not developed to evaluate worker safety.

EVALUATION RESULTS

The following are the remedial action alternatives that were analyzed with SiteWise™ and GSRx for the Site 1 FS located at NWIRP Bethpage:

- Alternative S-1: No Action
- Alternative S-2: Permeable Cover, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 10 mg/kg), Consolidation, and Land Use Controls
- Alternative S-3: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), and Land Use Controls
- Alternative S-4: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, and Land Use Controls
- Alternative S-5A: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), In-situ Solidification of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls

- Alternative S-5B: RCRA Cap, Limited Excavation and Offsite Disposal of PCB-Contaminated Soil (Greater than 25 mg/kg), Vertical Barrier, In-situ Solvent Extraction of PCB-Contaminated Soil (Greater than 50 mg/kg), and Land Use Controls
- Alternative S-6: Excavation and Offsite Disposal of PCB-Contaminated Soil (greater than 10 mg/kg), Soil Cover, and Land Use Controls
- Alternative S-7: Excavation and Offsite Disposal of PCB-Contaminated Soil (greater than 1 mg/kg)
- Alternative SV-1: No Action (Shut Down of the SVE Containment System)
- Alternative SV-2: Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System
- Alternative SV-3: Soil Vapor Monitoring, Land Use Controls, and Continued Operation of the SVE Containment System, and Enhanced Soil Vapor Extraction at Site 1
- Alternative G-1: No Action
- Alternative G-2: Monitoring and Land Use Controls
- Alternative G-3A: Monitoring, Land Use Controls, and Upgrade of the ONCT System with GAC
- Alternative G-3B: Monitoring, Land Use Controls, and Upgrade of the ONCT System with Ion Exchange Treatment

The following sections summarize the relative environmental impacts and primary impact drivers for the twelve alternatives and their respective metrics. Note that the no action alternatives result in no emissions because no actions were taken. In addition, this appendix includes the inventory sheets that were used for the SiteWise™/GSRx hybrid model. SiteWise™ and GSRx output summary sheets and related figures follow this summary and provide detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc.). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Table D-1.

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure D-1 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the alternatives evaluated and the y-axis represents the GHG emissions in metric ton of CO_2e. Figure D-2 shows the breakdown of the percent that each of the main activities of each alternative (x-axis) contributes to the GHG emissions (y-axis).

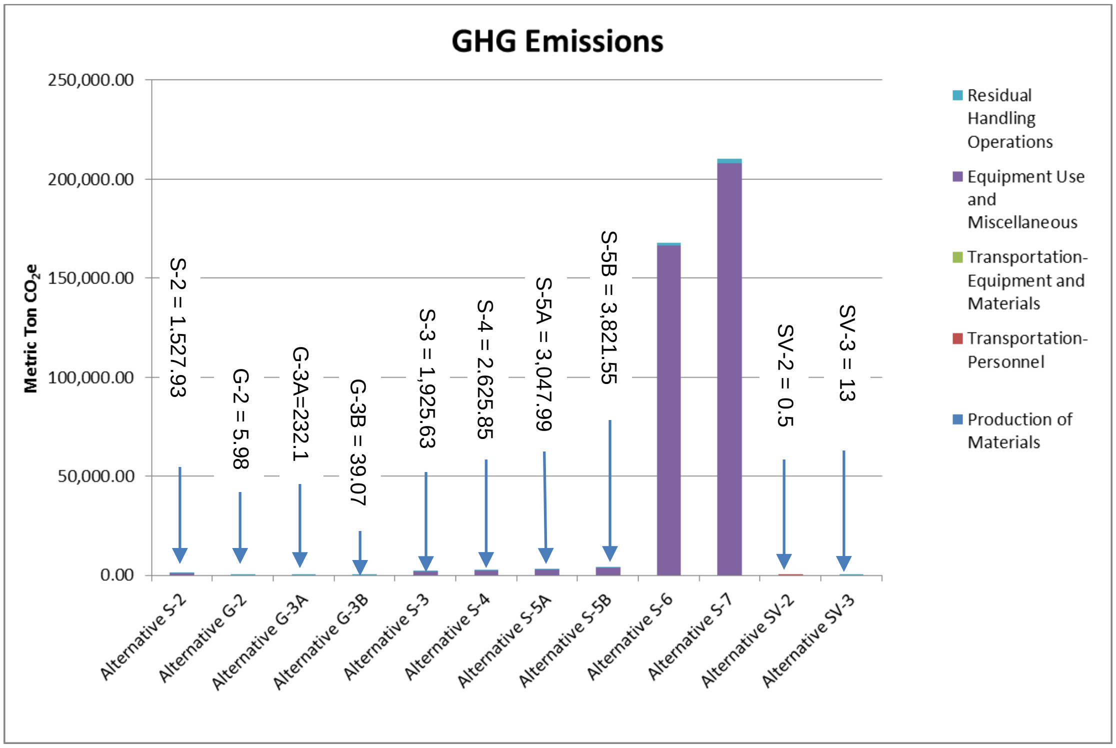


Figure D-1: GHG Emissions for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

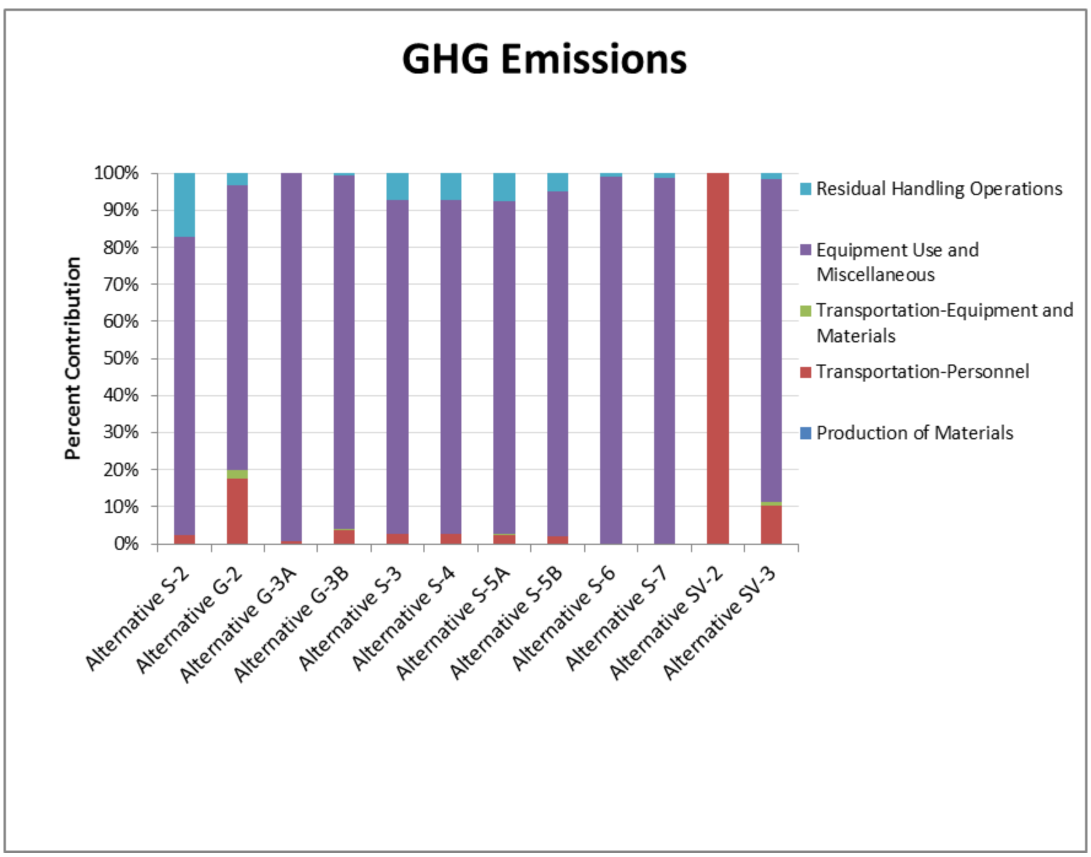


Figure D-2: GHG Emissions percentage breakdown for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

The total amount of GHG emissions from Alternative S-2 is 1,527.93 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 1,227.10 metric ton of CO_2e, corresponding to 80.3 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 264.03 metric ton of CO_2e released, corresponding to approximately 17.3 percent of the total GHG emissions. Transportation of personnel to and from the site is the activity with the third highest contribution to the CO_2e emissions, with 35.88 metric ton being released corresponding to 2.3 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative G-2 is 5.98 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 4.6 metric ton of CO_2e, corresponding to 76.9 percent of the total GHG emissions. The transportation of personnel is the activity with the second highest contribution to GHG emissions with 1.05 metric ton of CO_2e released, corresponding to approximately 17.5 percent of the total GHG emissions. Handling of residuals is the activity with the third highest contribution to the CO_2e emissions, with 0.19 metric ton being released corresponding to 3.1 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative G-3A is 232.1 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 230.33 metric ton of CO_2e, corresponding to 99.2 percent of the total GHG emissions. The transportation of personnel is the activity with the second highest contribution to GHG emissions with 1.43 metric ton of CO_2e released, corresponding to approximately 0.6 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative G-3B is 39.07 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 37.3 metric ton of CO_2e, corresponding to 95.5 percent of the total GHG emissions. The transportation of personnel is the activity with the second highest contribution to GHG emissions with 1.43 metric ton of CO_2e released, corresponding to approximately 3.6 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative S-3 is 1,925.63 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 1,734.03 metric ton of CO_2e, corresponding to 90.1 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 139.74 metric ton of CO_2e released, corresponding to approximately 7.3 percent of the total GHG emissions.

Transportation of personnel is the activity with the third highest contribution to the CO_2e emissions, with 50.93 metric ton being released corresponding to 2.6 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative S-4 is 2,625.85 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 2,363.98 metric ton of CO_2e, corresponding to 90 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 191.91 metric ton of CO_2e released, corresponding to approximately 7.3 percent of the total GHG emissions. Transportation of personnel is the activity with the third highest contribution to the CO_2e emissions, with 69.04 metric ton being released corresponding to 2.6 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative S-5A is 3,047.99 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 2,738.05 metric ton of CO_2e, corresponding to 89.8 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 232.47 metric ton of CO_2e released, corresponding to approximately 7.6 percent of the total GHG emissions. Transportation of personnel is the activity with the third highest contribution to the CO_2e emissions, with 76.55 metric ton being released corresponding to 2.5 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative S-5B is 3,821.55 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 3,548.05 metric ton of CO_2e, corresponding to 92.8 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 192.22 metric ton of CO_2e released, corresponding to approximately 5 percent of the total GHG emissions. Transportation of personnel is the activity with the third highest contribution to the CO_2e emissions, with 80.36 metric ton being released corresponding to 2.1 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative S-6 is 167,851.53 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 166,490.03 metric ton of CO_2e, corresponding to 99.2 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 1,270.96 metric ton of CO_2e released, corresponding to approximately 1 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative S-7 is 210,438.89 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 207,800.03 metric ton of CO_2e, corresponding to 98.7 percent of the total GHG emissions. The handling of residuals is the activity with the second highest contribution to GHG emissions with 2,479.15 metric ton of CO_2e released, corresponding to approximately 1.2 percent of the total GHG emissions.

The total amount of GHG emissions from Alternative SV-2 is 0.5 metric ton of CO_2e. The main contributor for the GHG emissions is the transportation of personnel.

The total amount of GHG emissions from Alternative SV-3 is 13 metric ton of CO_2e. The main contributor for the GHG emissions is the use of equipment and the amount of emissions resulting from this activity is 11.33 metric ton of CO_2e, corresponding to 87.2 percent of the total GHG emissions. The transportation of personnel is the activity with the second highest contribution to GHG emissions with 1.33 metric ton of CO_2e released, corresponding to approximately 10.3 percent of the total GHG emissions.

Criteria Pollutant Emissions

NO_X

Figure D-3 shows the overall NO_X emissions of each of the alternatives analyzed; the x-axis represents the alternatives evaluated and the y-axis represents the NO_X emissions in metric ton of NO_X. Figure D-4 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the NO_X emissions (y-axis).

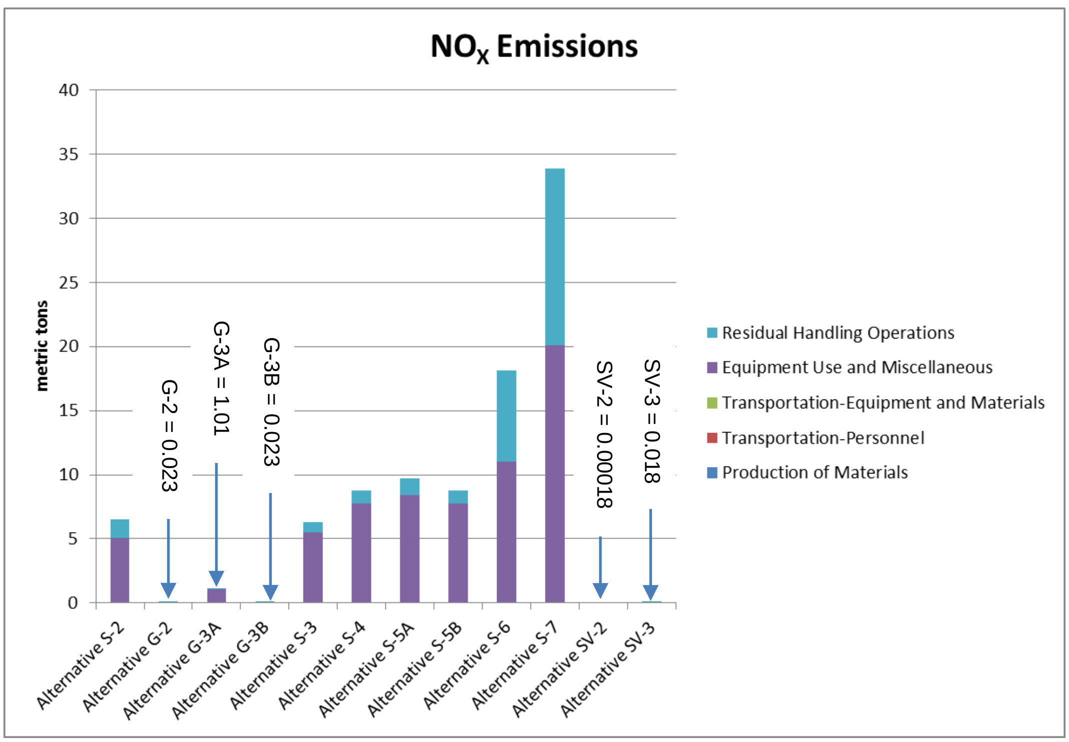


Figure D-3 NO_X Emissions for Alternatives at Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

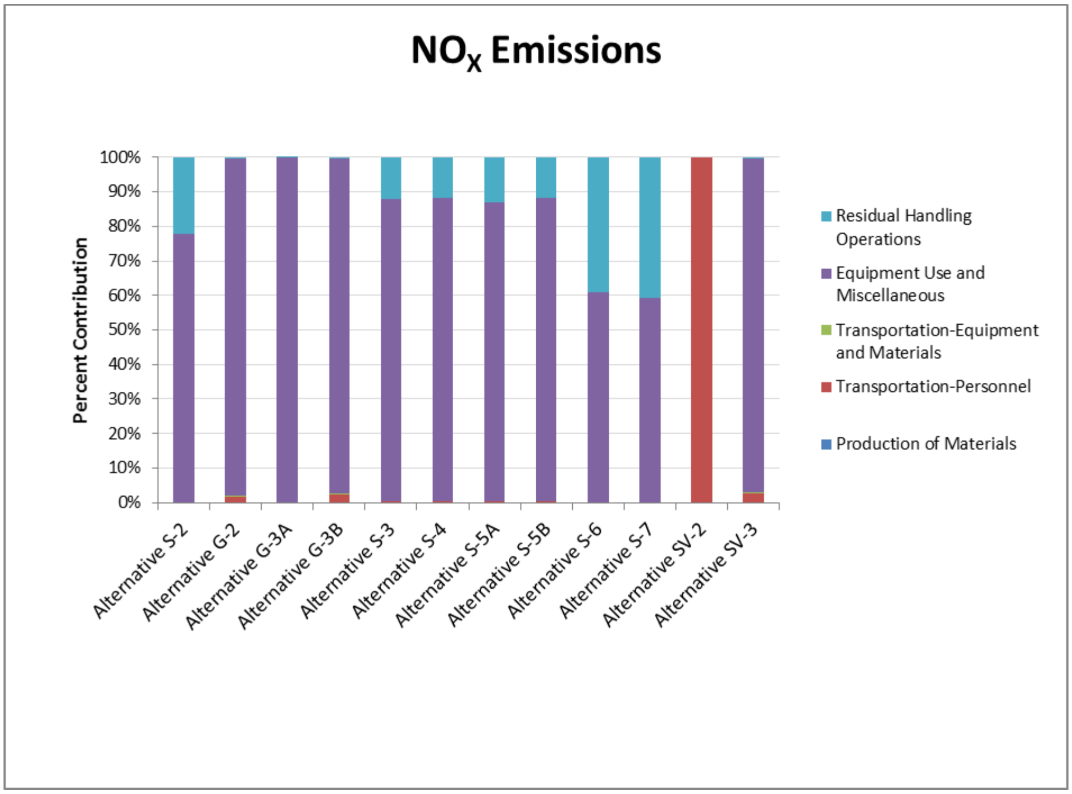


Figure D-4: NO_X Emissions percentage breakdown for Alternatives at Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

The total amount of NO_X emissions from Alternative S-2 is 6.51 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 5.04 metric ton of NO_X, corresponding to approximately 77.4 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 1.45 metric ton of NO_X, corresponding to approximately 22.2 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative G-2 is 0.023 metric ton. The activity with the most significant contribution to NO_X emissions is equipment use, emitting 0.022 metric ton of NO_X, corresponding to approximately 96 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative G-3A is 1.101 metric ton. The activity with the most significant contribution to NO_X emissions is equipment use, emitting 1.1 metric ton of NO_X, corresponding to approximately 99.9 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative G-3B is 0.023 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 0.022 metric ton of NO_X, corresponding to approximately 96 percent of the total NO_X emissions. The activities with the second highest contribution to

NO_X emissions is transportation of personnel with 000054 metric ton of NO_X corresponding to approximately 2.3 percent of the total NO_X emissions, respectively.

The total amount of NO_X emissions from Alternative S-3 is 6.275 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 5.5 metric ton of NO_X, corresponding to approximately 87.6 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 0.76 metric ton of NO_X, corresponding to approximately 12.1 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative S-4 is 8.783 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 7.71 metric ton of NO_X, corresponding to approximately 87.8 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 1.05 metric ton of NO_X, corresponding to approximately 11.9 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative S-5A is 9.7 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 8.4 metric ton of NO_X, corresponding to approximately 86.5 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 1.27 metric ton of NO_X, corresponding to approximately 13.1 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative S-5B is 8.78 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 7.7 metric ton of NO_X, corresponding to approximately 87.7 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 1.05 metric ton of NO_X, corresponding to approximately 11.9 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative S-6 is 18.1 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 11 metric ton of NO_X, corresponding to approximately 60.7 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 7.09 metric ton of NO_X, corresponding to approximately 39.2 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative S-7 is 33.9 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 20 metric ton of NO_X, corresponding to approximately 58.9 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the handling of residuals, emitting 13.9 metric ton of NO_X, corresponding to approximately 41 percent of the total NO_X emissions.

The total amount of NO_X emissions from Alternative SV-2 is 0.00018 metric ton. The main contributor to NO_X emissions is transportation of personnel.

The total amount of NO_X emissions from Alternative SV-3 is 0.018 metric ton. The activity with the highest contribution to NO_X emissions is equipment use, emitting 0.017 metric ton of NO_X, corresponding to approximately 94.4 percent of the total NO_X emissions. The activity with the second highest contribution to NO_X emissions is the transportation of personnel, emitting 0.00049 metric ton of NO_X, corresponding to approximately 2.7 percent of the total NO_X emissions.

SO_X

Figure D-5 shows the overall SO_X emissions of each of the alternatives analyzed; the x-axis represents the alternatives evaluated and the y-axis represents the SO_X emissions in metric ton of SO_X. Figure D-6 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the SO_X emissions (y-axis).

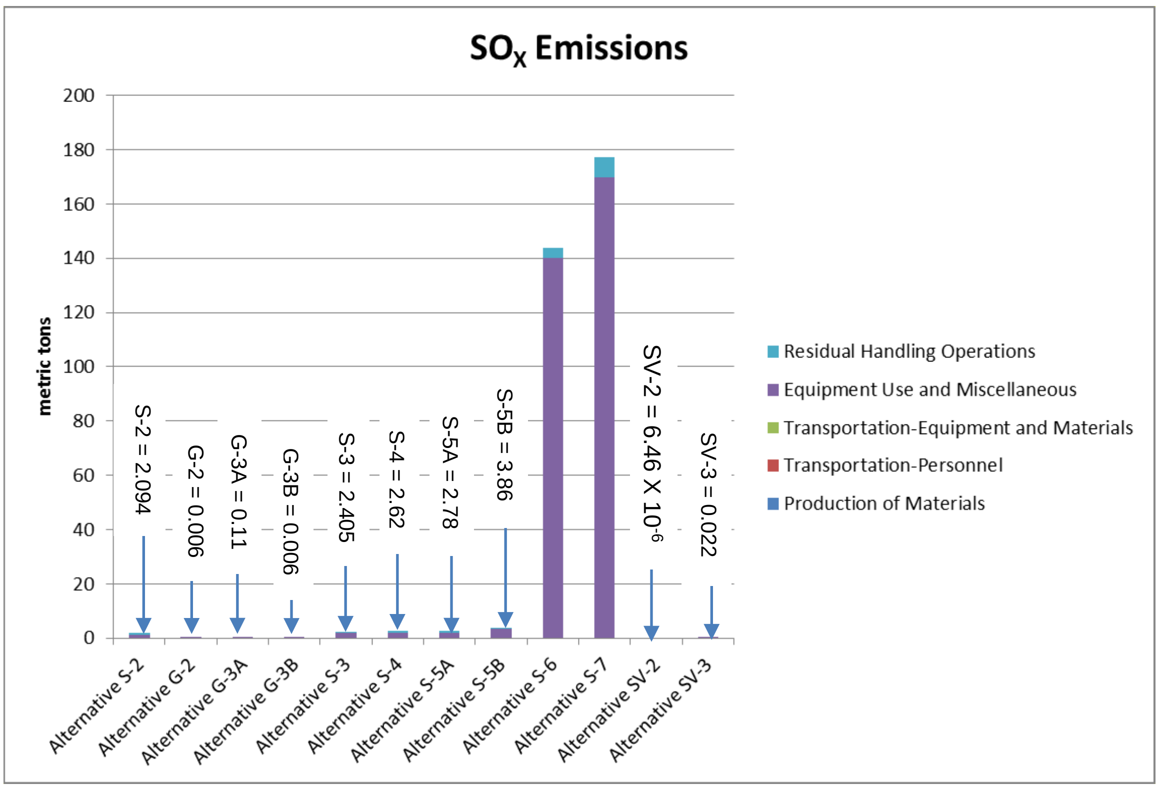


Figure D-5: SO_X Emissions for Alternatives at Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

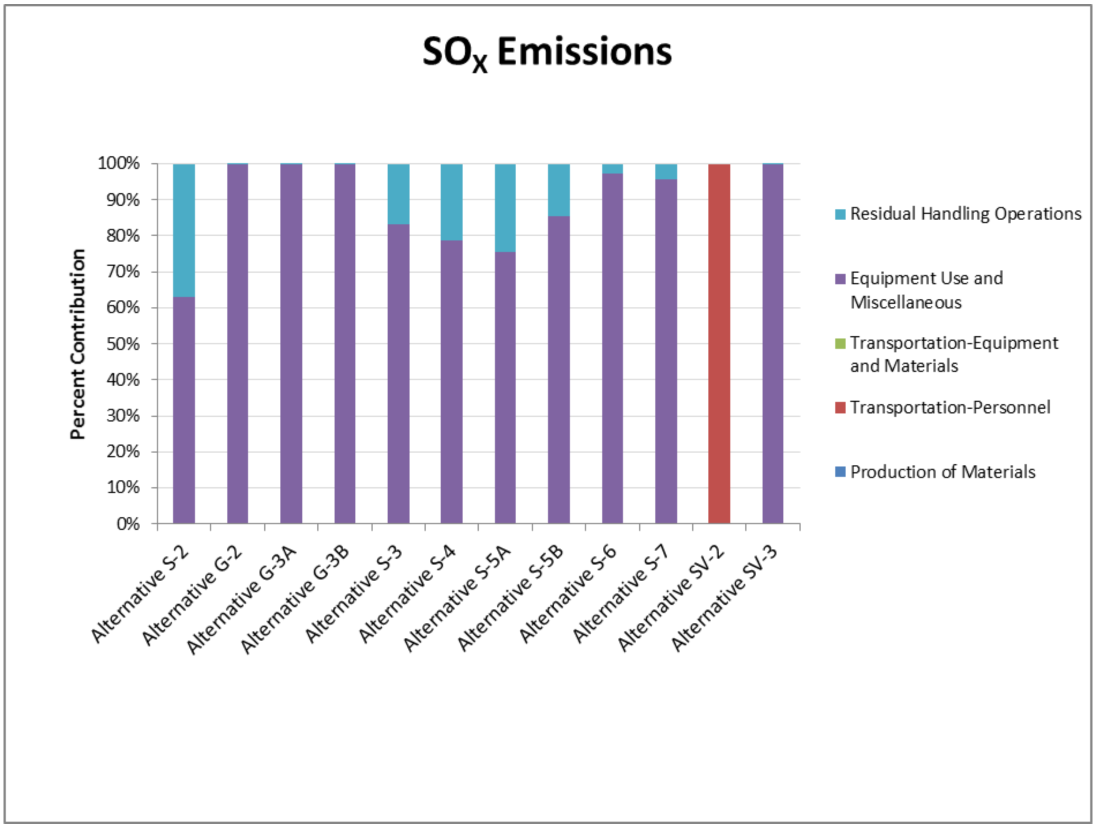


Figure D-6: SO_X Emissions percentage breakdown for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

The total amount of SO_X emissions from Alternative S-2 is 2.094 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 1.32 metric ton of SO_X, corresponding to approximately 63 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 0.77 metric ton of SO_X, corresponding to approximately 36.7 percent of the total emissions.

The total amount of SO_X emissions from Alternative G-2 is 0.006 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 0.0057 metric ton of SO_X, corresponding to approximately 95 percent of the total SO_X emissions. The activity with the second highest contribution to SO_X emissions is the transportation of personnel, emitting 1.37 x 10^{-5} metric ton of SO_X, corresponding to approximately 0.2 percent of the total emissions.

The total amount of SO_X emissions from Alternative G-3A is 0.11 metric ton. The main activity that contributes to SO_X emissions is equipment use.

The total amount of SO_X emissions from Alternative G-3B is 0.006 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 0.0057 metric ton of SO_X, corresponding to approximately 95 percent of the total SO_X emissions. The transportation of personnel is the activity with the second highest contribution and emits 1.86 $\times 10^{-5}$ metric ton of SO_X, corresponding to approximately 0.3 percent of the total emissions.

The total amount of SO_X emissions from Alternative S-3 is 2.405 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 2.0 metric ton of SO_X, corresponding to approximately 83.2 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 0.4 metric ton of SO_X, corresponding to approximately 16.6 percent of the total emissions.

The total amount of SO_X emissions from Alternative S-4 is 2.62 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 2.06 metric ton of SO_X, corresponding to approximately 78.6 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 0.56 metric ton of SO_X, corresponding to approximately 21.4 percent of the total emissions.

The total amount of SO_X emissions from Alternative S-5A is 2.78 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 2.1 metric ton of SO_X, corresponding to approximately 75.5 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 0.68 metric ton of SO_X, corresponding to approximately 24.5 percent of the total emissions.

The total amount of SO_X emissions from Alternative S-5B is 3.86 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 3.3 metric ton of SO_X, corresponding to approximately 85.5 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 0.56 metric ton of SO_X, corresponding to approximately 14.5 percent of the total emissions.

The total amount of SO_X emissions from Alternative S-6 is 144 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 140 metric ton of SO_X, corresponding to approximately 97.2 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 3.8 metric ton of SO_X, corresponding to approximately 2.6 percent of the total emissions.

The total amount of SO_X emissions from Alternative S-7 is 177 metric ton. The activity with the highest contribution to SO_X emissions is equipment use, emitting 170 metric ton of SO_X, corresponding to approximately 96 percent of the total SO_X emissions. The handling of residuals is the activity with the second highest contribution and emits 7.4 metric ton of SO_X, corresponding to approximately 4.0 percent of the total emissions.

The total amount of SO_X emissions from Alternative SV-2 is 6.46 x 10^{-6} metric ton. The only activity that contributes to SO_X emissions is the transportation of personnel.

The total amount of SO_X emissions from Alternative SV-3 is 0.022 metric ton. The only activity that contributes to SO_X emissions is equipment use.

PM_{10}

Figure D-7 shows the overall PM_{10} emissions of each alternative analyzed; the x-axis represents the alternatives evaluated and the y-axis represents the PM_{10} emissions in metric ton of PM_{10}. Figure D-8 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the PM_{10} emissions (y-axis).

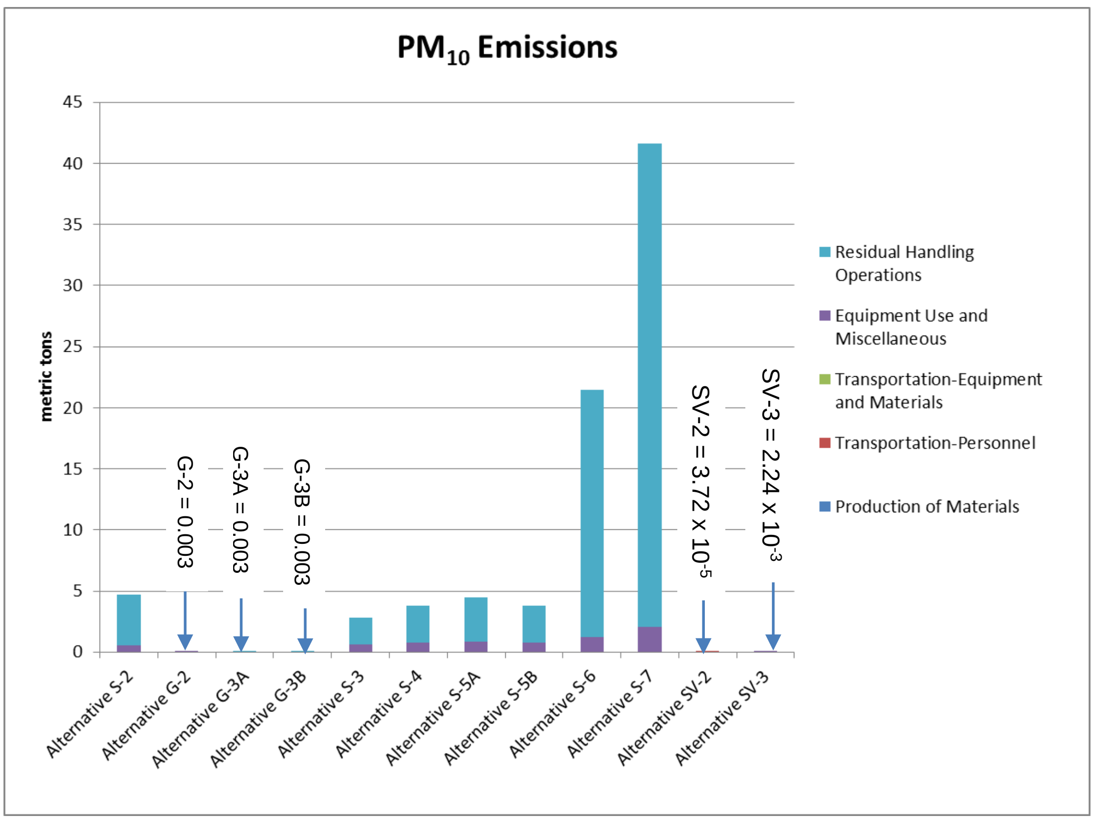


Figure D-7: PM_{10} Emissions for Alternatives at Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

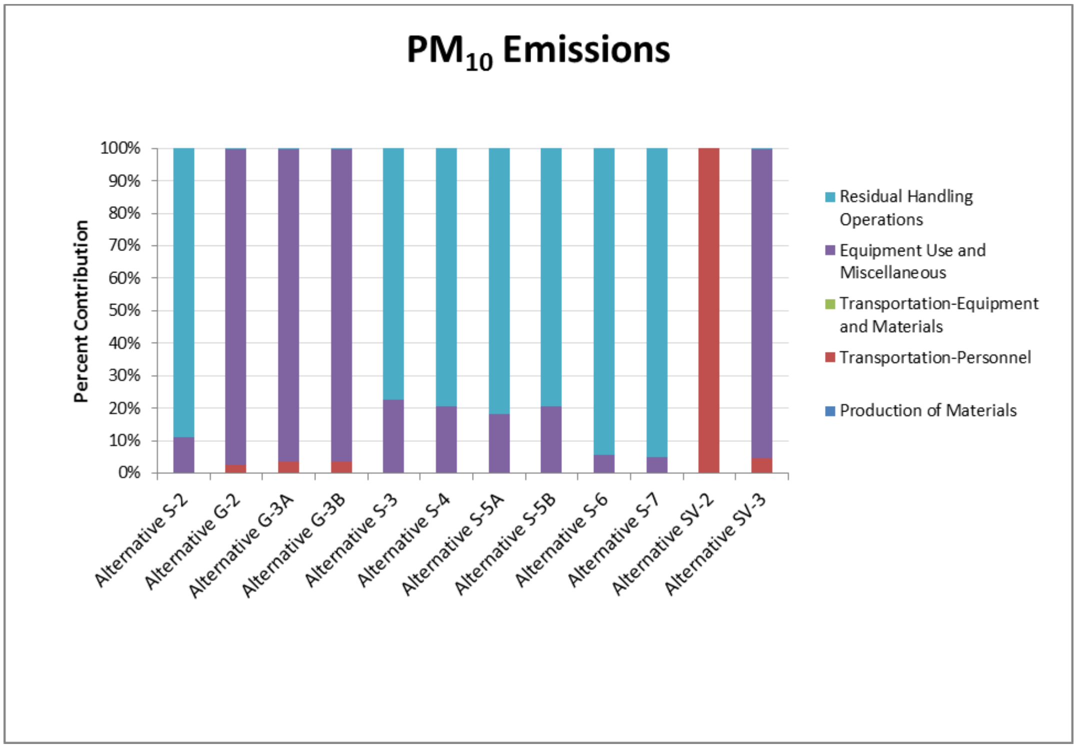


Figure D-8: PM_{10} Emissions percentage breakdown for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

The total PM_{10} emissions resulting from Alternative S-2 is 4.661 metric ton. The activity with the highest contribution to these emissions is the handling of residuals, emitting 4.14 metric ton of PM_{10}, approximately 88.8 percent of the total PM_{10} emissions. Use of equipment is the activity with the second highest contribution and emits 0.51 metric ton of PM_{10}, corresponding to approximately 10.9 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative G-2 is 0.003 metric ton. The activity with the highest contribution to these emissions is equipment use, emitting 2.93 x 10^{-3} metric ton of PM_{10}, approximately 97.6 percent of the total PM_{10} emissions. Transportation of personnel is the activity with the second highest contribution and emits 7.87 x10^{-5} metric ton of PM_{10}, corresponding to approximately 3.0 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative G-3A is 0.003 metric ton. The activity with the highest contribution to these emissions is equipment use, emitting 2.93 x10^{-3} metric ton of PM_{10}, approximately 97.6 percent of the total PM_{10} emissions. Transportation of personnel is the activity with the second highest contribution and emits 1.07 x10^{-4} metric ton of PM_{10}, corresponding to approximately 3.0 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative S-3 is 2.9 metric ton. The activity with the highest contribution to these emissions is the handling of residuals, emitting 2.16 metric ton of PM_{10}, approximately 77.4 percent of the total PM_{10} emissions. Equipment use is the activity with the second highest contribution and emits 0.63 metric ton of PM_{10}, corresponding to approximately 22.6 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative S-4 is 2.9 metric ton. The activity with the highest contribution to these emissions is equipment use, emitting 2.16 metric ton of PM_{10}, approximately 77.4 percent of the total PM_{10} emissions. Equipment use is the activity with the second highest contribution and emits 0.63 metric ton of PM_{10}, corresponding to approximately 22.6 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative S-5A is 4.45 metric ton. The activity with the highest contribution to these emissions is the handling of residuals, emitting 3.63 metric ton of PM_{10}, approximately 81.6 percent of the total PM_{10} emissions. Equipment use is the activity with the second highest contribution and emits 0.81 metric ton of PM_{10}, corresponding to approximately 18.2 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative S-5B is 3.77 metric ton. The activity with the highest contribution to these emissions is the handling of residuals, emitting 2.99 metric ton of PM_{10}, approximately 79.3 percent of the total PM_{10} emissions. Equipment use is the activity with the second highest contribution and emits 0.77 metric ton of PM_{10}, corresponding to approximately 20.4 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative S-6 is 21.5 metric ton. The activity with the highest contribution to these emissions is the handling of residuals, emitting 20.3 metric ton of PM_{10}, approximately 94.4 percent of the total PM_{10} emissions. Equipment use is the activity with the second highest contribution and emits 1.2 metric ton of PM_{10}, corresponding to approximately 5.6 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative S-7 is 41.6 metric ton. The activity with the highest contribution to these emissions is the handling of residuals, emitting 39.6 metric ton of PM_{10}, approximately 95.2 percent of the total PM_{10} emissions. Equipment use is the activity with the second highest contribution and emits 2.0 metric ton of PM_{10}, corresponding to approximately 4.8 percent of the total emissions.

The total PM_{10} emissions resulting from Alternative SV-2 is 3.72×10^{-5} metric ton. The main activity that contributes to these emissions is the transportation of personnel.

The total PM_{10} emissions resulting from Alternative SV-3 is 2.24×10^{-3} metric ton. The activity with the highest contribution to these emissions is equipment use, emitting 2.13×10^{-3} metric ton of PM_{10}, approximately 95.1 percent of the total PM_{10} emissions. Transportation of personnel is the activity with the second highest contribution and emits 1.0×10^{-4} metric ton of PM_{10}, corresponding to approximately 4.5 percent of the total emissions.

Energy Consumption

Figure D-9 shows the energy consumption of each of the alternatives; the x-axis represents the alternatives evaluated and the y-axis represents the amount of energy consumed in units of million British Thermal Units (MMBTU). Figure D-10 shows the percentage breakdown contribution of energy consumption from the different activity groups for each alternative.

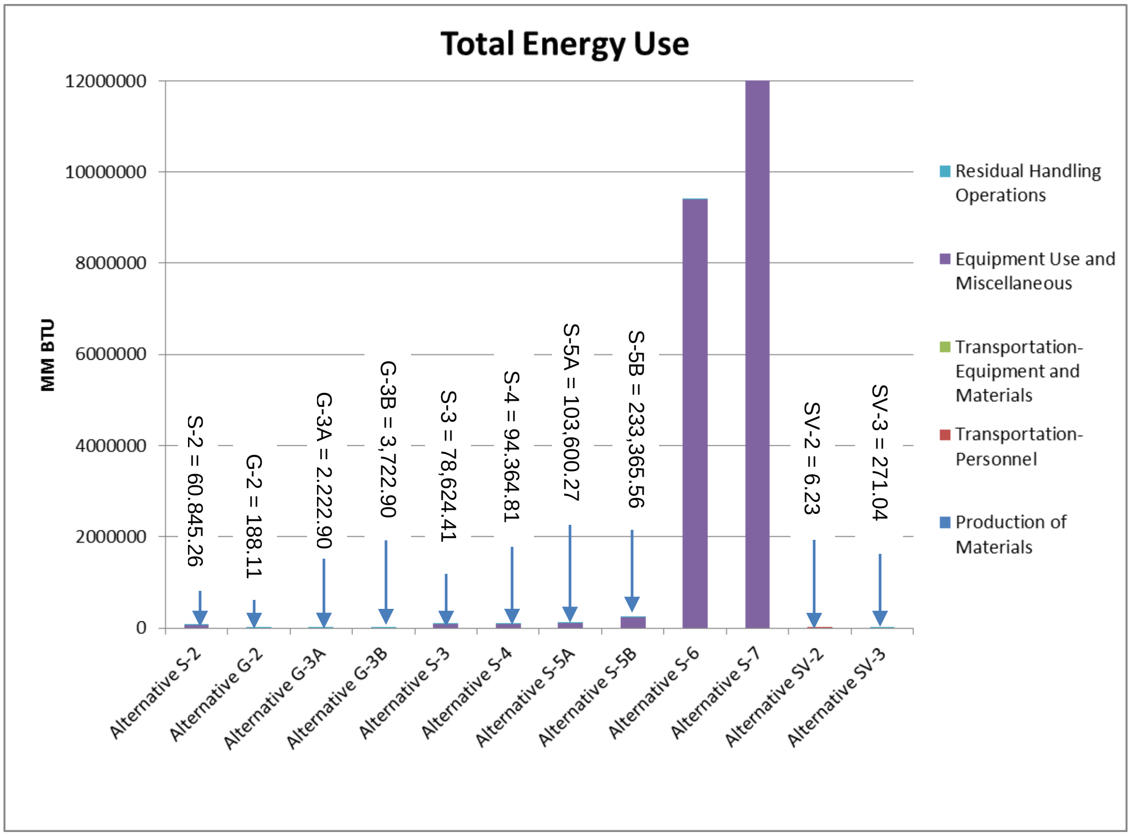


Figure D-9: Energy Consumption for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

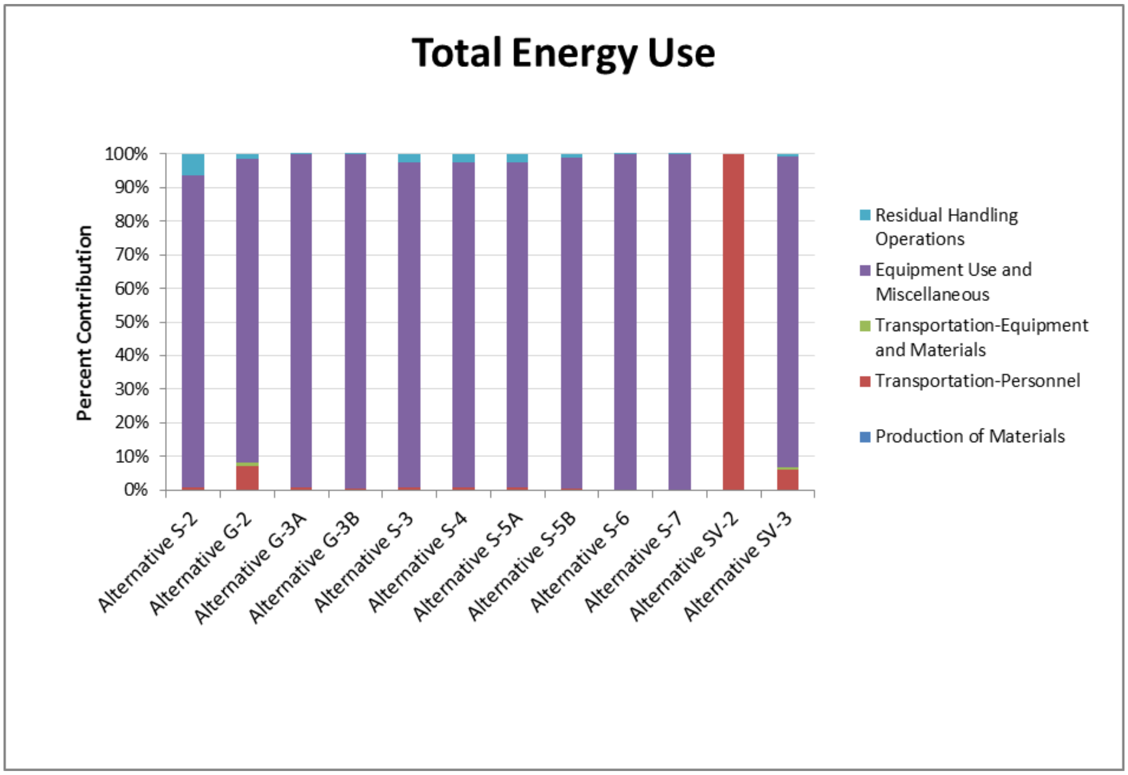


Figure D-10: Energy Consumption percentage for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

The total amount of energy consumed by Alternative S-2 is 60,845.26 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 56,576.47 MMBTU, corresponding to approximately 92.9 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, consuming 3,804.84 MMBTU, approximately 6.3 percent of the total energy consumption of this alternative. The third highest activity consuming energy corresponds to transportation of personnel, where 451.32 MMBTUs are consumed, approximately 0.7 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative G-2 is 188.11 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 170.32 MMBTU, corresponding to approximately 90.5 percent of the total energy consumption. The activity with the second highest energy use is the transportation of personnel, where 13.18 MMBTUs are consumed, approximately 7.0 percent of the total energy used during this alternative. The third highest activity consuming energy corresponds to the handling of residuals, consuming 2.64 MMBTU, approximately 1.4 percent of the total energy consumption of this alternative.

The total amount of energy consumed by Alternative G-3A is 2,222.90 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 2,200.32 MMBTU, corresponding to approximately 98.9 percent of the total energy consumption. The activity with the second highest energy use is the transportation of personnel, where 17.98 MMBTUs are consumed, approximately 0.8 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative G-3B is 3,722.90 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 3,700.32 MMBTU, corresponding to approximately 99.4 percent of the total energy consumption. The activity with the second highest energy use is the transportation of personnel, where 17.98 MMBTUs are consumed, approximately 0.5 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative S-3 is 78,624.41 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 76,000.97 MMBTU, corresponding to approximately 96.7 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, where 1,970.14 MMBTUs are consumed, approximately 2.5 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative S-4 is 94,364.81 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 91,147.44 MMBTU, corresponding to approximately 96.6 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, where 2,336.38 MMBTUs are consumed, approximately 2.5 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative S-5A is 103,600.27 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 100,001.61 MMBTU, corresponding to approximately 96.5 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, where 2,623.23 MMBTUs are consumed, approximately 2.5 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative S-5B is 233,365.56 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 230,001.61 MMBTU, corresponding to approximately 98.6 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, where 2,340.59 MMBTUs are consumed, approximately 1.0 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative S-6 is 9,413,957.22 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 9,400,000.97 MMBTU, corresponding to approximately 99.9 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, where 12,816.41 MMBTUs are consumed, approximately 0.1 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative S-7 is 12,023,290.75 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 12,000,000.97 MMBTU, corresponding to approximately 99.8 percent of the total energy consumption. The activity with the second highest energy use is the handling of residuals, where 21,279.89 MMBTUs are consumed, approximately 0.2 percent of the total energy used during this alternative.

The total amount of energy consumed by Alternative SV-2 is 6.23 MMBTU. The main contributor is the transportation of personnel.

The total amount of energy consumed by Alternative SV-3 is 271.04 MMBTU. The activity with the highest energy consumption is the use of equipment, utilizing 249.66 MMBTU, corresponding to approximately 92.1 percent of the total energy consumption. The activity with the second highest energy use is the transportation of personnel, consuming 16.78 MMBTU, approximately 6.2 percent of the total energy consumption of this alternative. The third highest activity consuming energy corresponds to residual's handling, where 2.64 MMBTUs are consumed, approximately 1.0 percent of the total energy used during this alternative.

Water Usage

The water consumption of the evaluated alternatives is shown in Figure D-11. The x-axis shows the alternatives evaluated and the y-axis shows the amount of water consumed in thousands of gallons. Figure D-12 shows the percentage breakdown contribution of the different sectors of water use through the lifetime of each of the alternatives.

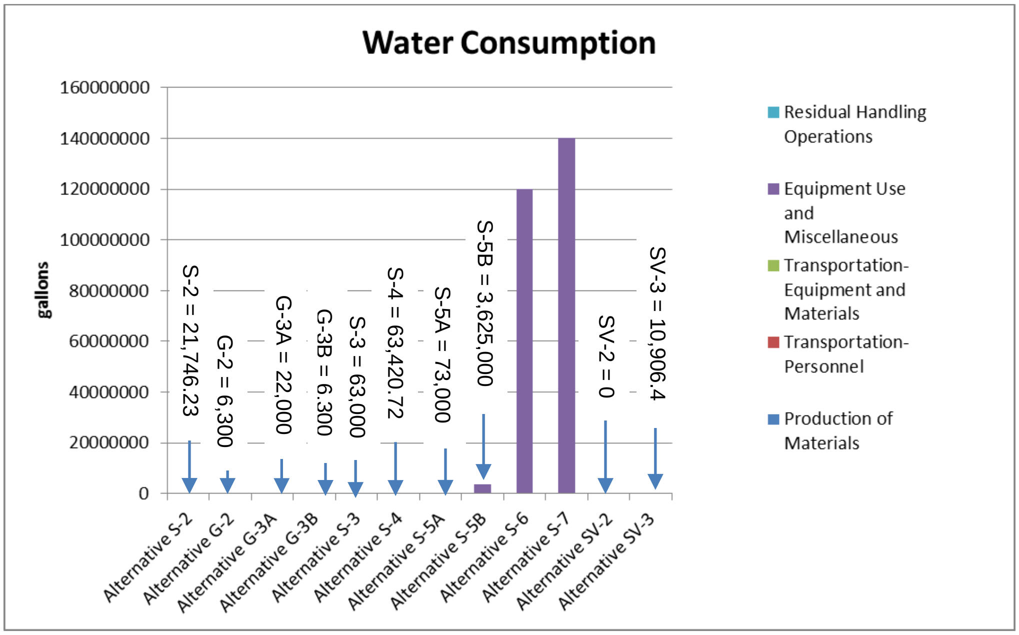


Figure D-11: Water Consumption for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

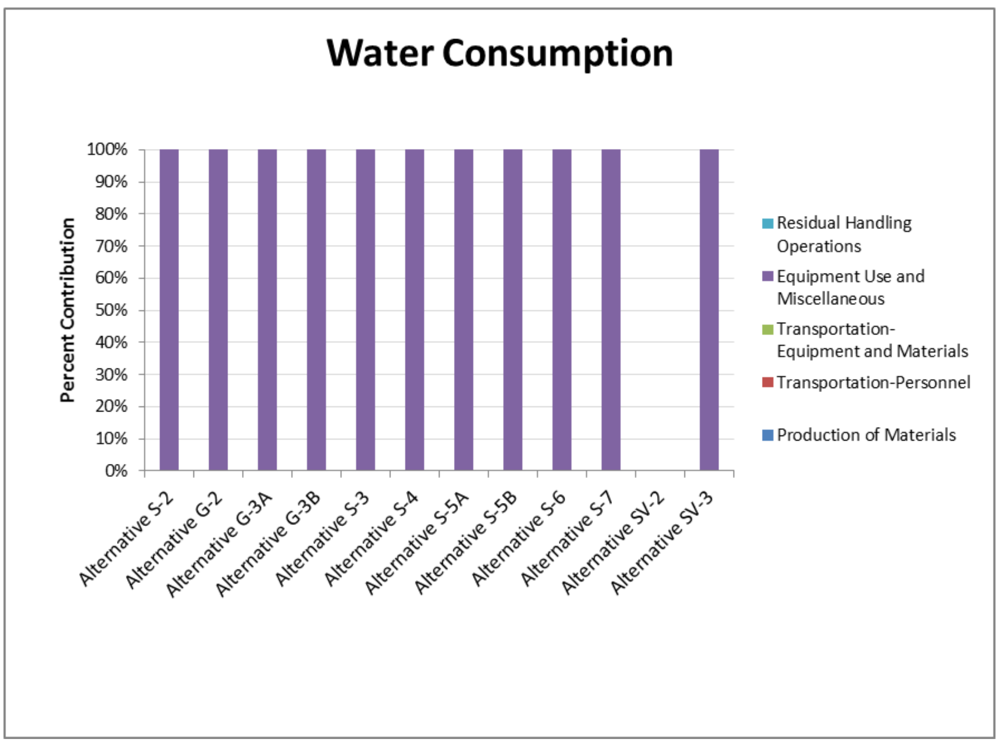


Figure D-12: Water Consumption percentage breakdown for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

The total water consumption for Alternative S-2 is 21,746.23 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative G-2 is 6,300 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative G-3A is 22,000 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative G-3B is 6,300 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative S-3 is 63,000 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative S-4 is 63,420.72 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative S-5A is 73,000 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative S-5B is 3,625,000 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative S-6 is 120,015,000 gallons of water. All water is consumed in equipment usage and site activities.

The total water consumption for Alternative S-7 is 140,015,000 gallons of water. All water is consumed in equipment usage and site activities.

No water is consumed under Alternative SV-2 for equipment use or site activities during remedial action construction.

The total water consumption for Alternative SV-3 is 10,906.40 gallons of water. All water is consumed in equipment usage and site activities.

Accident Risk

Accident Risk Fatality

Figure D-13 shows the risk of fatality between the evaluated alternatives. The x-axis represents the alternatives evaluated, and the y-axis represents the risk of fatality.

For all twelve alternatives evaluated, the activity with the highest risk of fatality is the transportation of personnel.

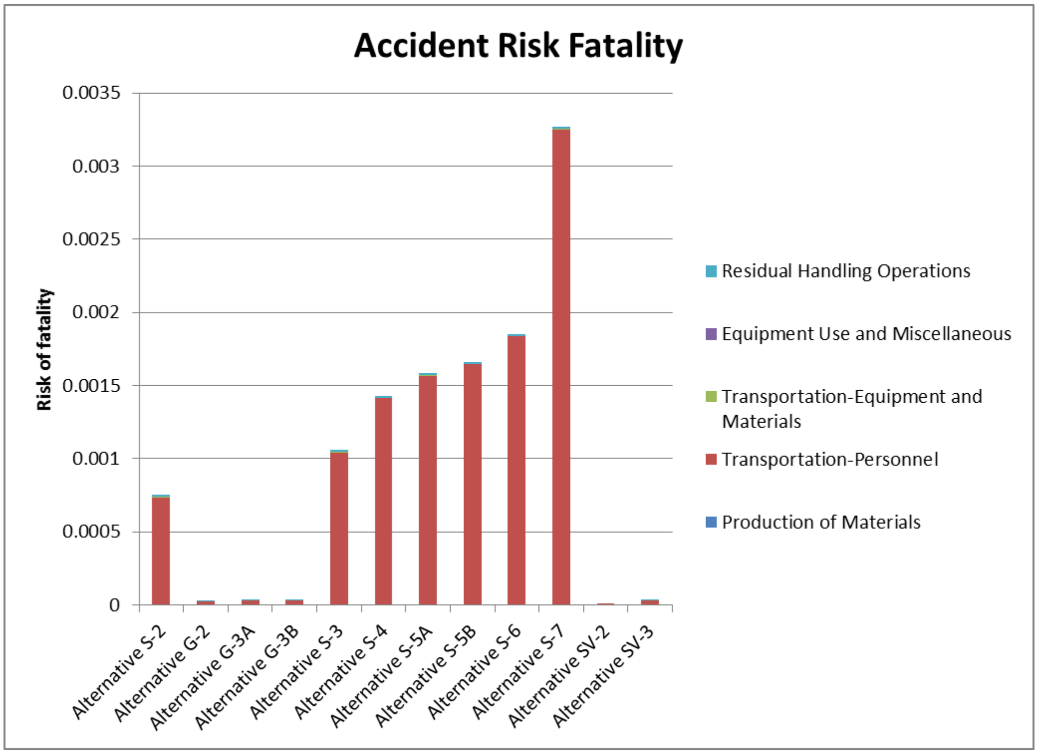


Figure D-13 Risk of Fatality for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

Accident Risk Injury

Figure D-14 shows the risk of injury between the evaluated alternatives. The x-axis represents the alternatives evaluated, and the y-axis represents the risk of injury.

For all twelve alternatives evaluated, the activity with the highest risk of injury is the transportation of personnel.

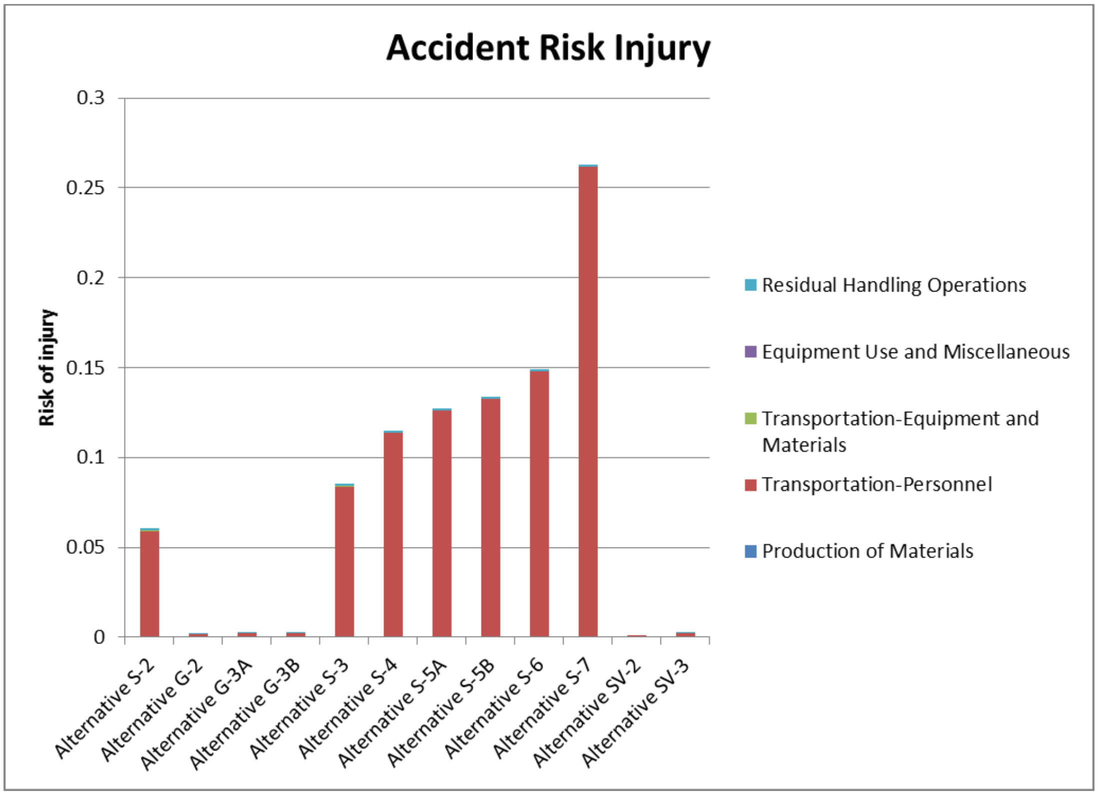


Figure D-14 Risk of Injury for Alternatives at Naval Weapons Industrial Reserve Plant Bethpage Site 1

CONCLUSIONS AND RECOMMENDATIONS

During selection and design of the remedy, a sensitivity analysis considering elements of the remedy that have the greatest impact on remedy effectiveness, life-cycle cost, and environmental footprint metrics may provide additional insight into appropriate optimization. To aid in the sensitivity analysis, an impact analysis summary was created to qualitatively highlight the relative impact of respective metrics for the eight alternatives and to identify the primary drivers of emissions, energy consumption, and water usage for each alternative (see Table D-2 for details).

Figures D-2, D-4, D-6, D-8, D-10 and D-12 show the percentage breakdown of each of the sectors that take place during the proposed remedial alternatives. In these graphs, it is easy to identify the sector whose contribution is largest from all other sectors to that impact category. Identifying where the large contributions occur optimizes the process for potentially lowering the environmental impacts of each of the phases evaluated. Considering this, the following recommendations could noticeably reduce the environmental footprint of the phases listed below.

- For all Alternatives: Equipment usage and site activities are the largest contributors to most of the impact categories for all alternatives. It is recommended that the use of necessary equipment be limited as much as possible through clear and concise planning. Overlap of site activities would reduce the overall time of the remedial construction phase, and therefore reduce the total time of equipment use.

- For Alternatives S-2, G-2, G-3A, G-3B, SV-2, and SV-3: Transportation of personnel is a main or secondary contributor that could potentially have a reduced impact if the number of trips to the site and number of people required at the site could be limited.
- For all Alternatives: Some reduction of the environmental footprint, particularly GHG emissions and energy consumption, could be realized for all phases through the possible use of emission control measures such as alternate fuel sources (e.g. biodiesel), equipment exhaust controls (e.g. diesel), and equipment idle reduction. This model was run using default values, assuming that these measures were not taking place.

REFERENCES

(a) NAVFAC, DON Guidance for Optimizing Remedy Evaluation, Selection, and Design, March 2010

(b) NAVFAC, DON Policy on SiteWise™ Optimization/GSR Tool Usage, email received from Brian Harrison/NAVFAC HQ dated 10 AUG 2010

Remedial Alternatives	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
Alternative S-2	0.01	0.01	0.00	0.19	0.01	0.11	0.23	0.23
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative G-2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Transportation of Personnel	Transportation of Personnel
Alternative G-3A	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.01
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Transportation of Personnel	Transportation of Personnel
Alternative G-3B	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Transportation of Personnel	Transportation of Personnel
Alternative S-3	0.01	0.01	0.00	0.19	0.01	0.07	0.32	0.32
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative S-4	0.01	0.01	0.00	0.26	0.01	0.09	0.44	0.44
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative S-5A	0.01	0.01	0.00	0.29	0.02	0.11	0.48	0.48
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative S-5B	0.02	0.02	0.03	0.26	0.02	0.09	0.51	0.51
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative S-6	0.80	0.78	0.86	0.53	0.81	0.52	0.57	0.57
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative S-7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Handling of Residuals	Transportation of Personnel	Transportation of Personnel
Alternative SV-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Transportation of Personnel	Transportation of Personnel	N/A	Transportation of Personnel	Transportation of Personnel	Transportation of Personnel	Transportation of Personnel	Transportation of Personnel
Alternative SV-3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Equipment Use	Transportation of Personnel	Transportation of Personnel

0-0.2	low
0.21-0.4	low to moderate
0.4-0.6	moderate
0.61-0.8	moderate to high
0.81-1	high

Alternative	Activities	GHG Emissions metric ton CO_2e	Total Energy Used MMBTU	Water Impacts gallons	NO_X Emissions metric ton	SO_X Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Alternative S-2	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	35.88	451.32	NA	1.33E-02	4.68E-04	2.69E-03	7.34E-04	5.91E-02
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	1,227.10	56,576.47	21,746.23	5.04E+00	1.32E+00	5.14E-01	0.00E+00	0.00E+00
	Residual Handling	264.03	3,804.84	NA	1.45E+00	7.77E-01	4.14E+00	1.33E-05	1.07E-03
	Total	1,527.93	60,845.26	21,746.23	6.510	2.094	4.661	0.001	0.060
Alternative G-2	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	1.05	13.18	NA	3.88E-04	1.37E-05	7.87E-05	2.15E-05	1.73E-03
	Transportation-Equipment	0.14	1.96	NA	4.61E-05	1.88E-06	3.74E-06	7.80E-07	6.28E-05
	Equipment Use and Misc	4.60	170.32	6,300.00	2.20E-02	5.71E-03	2.93E-03	0.00E+00	0.00E+00
	Residual Handling	0.19	2.64	NA	6.21E-05	2.53E-06	5.03E-06	7.80E-07	6.28E-05
	Total	5.98	188.11	6,300.00	0.023	0.006	0.003	0.000	0.002
Alternative G-3A	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	1.43	17.98	NA	5.29E-04	1.86E-05	1.07E-04	2.93E-05	2.35E-03
	Transportation-Equipment	0.14	1.96	NA	4.61E-05	1.88E-06	3.74E-06	7.80E-07	6.28E-05
	Equipment Use and Misc	230.33	2,200.32	22,000.00	1.10E+00	1.10E-01	2.93E-03	0.00E+00	0.00E+00
	Residual Handling	0.19	2.64	NA	6.21E-05	2.53E-06	5.03E-06	7.80E-07	6.28E-05
	Total	232.10	2,222.90	22,000.00	1.101	0.110	0.003	0.000	0.002
Alternative G-3B	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	1.43	17.98	NA	5.29E-04	1.86E-05	1.07E-04	2.93E-05	2.35E-03
	Transportation-Equipment	0.14	1.96	NA	4.61E-05	1.88E-06	3.74E-06	7.80E-07	6.28E-05
	Equipment Use and Misc	37.30	3,700.32	6,300.00	2.20E-02	5.71E-03	2.93E-03	0.00E+00	0.00E+00
	Residual Handling	0.19	2.64	NA	6.21E-05	2.53E-06	5.03E-06	7.80E-07	6.28E-05
	Total	39.07	3,722.90	6,300.00	0.023	0.006	0.003	0.000	0.002
Alternative S-3	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	50.93	640.67	NA	1.88E-02	6.64E-04	3.82E-03	1.04E-03	8.39E-02
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	1,734.03	76,000.97	63,000.00	5.50E+00	2.00E+00	6.30E-01	0.00E+00	0.00E+00
	Residual Handling	139.74	1,970.14	NA	7.56E-01	4.04E-01	2.16E+00	1.33E-05	1.07E-03
	Total	1,925.63	78,624.41	63,000.00	6.275	2.405	2.789	0.001	0.085
Alternative S-4	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	69.04	868.37	NA	2.55E-02	9.00E-04	3.82E-03	1.41E-03	1.14E-01
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	2,363.98	91,147.44	63,420.72	7.71E+00	2.06E+00	6.30E-01	0.00E+00	0.00E+00
	Residual Handling	191.91	2,336.38	NA	1.05E+00	5.61E-01	2.16E+00	1.33E-05	1.07E-03
	Total	2,625.85	94,364.81	63,420.72	8.783	2.620	2.789	0.001	0.115
Alternative S-5A	Materials Production	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	76.55	962.80	NA	2.83E-02	9.98E-04	5.74E-03	1.57E-03	5.91E-02
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	2,738.05	100,001.61	73,000.00	8.40E+00	2.10E+00	8.10E-01	0.00E+00	0.00E+00
	Residual Handling	232.47	2,623.23	NA	1.27E+00	6.81E-01	3.63E+00	1.40E-05	1.07E-03
	Total	3,047.99	103,600.27	73,000.00	9.70E+00	2.78E+00	4.45E+00	1.58E-03	6.04E-02
Alternative S-5B	Materials Production	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	80.36	1,010.74	NA	2.97E-02	1.05E-03	6.03E-03	1.64E-03	1.32E-01
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	3,548.05	230,001.61	3,625,000.00	7.70E+00	3.30E+00	7.70E-01	0.00E+00	0.00E+00
	Residual Handling	192.22	2,340.59	NA	1.05E+00	5.61E-01	2.99E+00	1.40E-05	1.13E-03
	Total	3,821.55	233,365.56	3,625,000.00	8.78E+00	3.86E+00	3.77E+00	1.66E-03	1.34E-01
Alternative S-6	Materials Production	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	89.62	1,127.22	NA	3.32E-02	1.17E-03	6.73E-03	1.83E-03	1.48E-01
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	166,490.03	9,400,000.97	120,015,000.00	1.10E+01	1.40E+02	1.20E+00	0.00E+00	0.00E+00
	Residual Handling	1,270.96	12,816.41	NA	7.09E+00	3.80E+00	2.03E+01	1.33E-05	1.07E-03
	Total	167,851.53	9,413,957.22	120,015,000.00	1.81E+01	1.44E+02	2.15E+01	1.85E-03	1.49E-01
Alternative S-7	Materials Production	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	158.79	1,997.27	NA	5.87E-02	2.07E-03	1.19E-02	3.25E-03	2.62E-01
	Transportation-Equipment	0.92	12.62	NA	2.97E-04	1.21E-05	2.41E-05	2.34E-06	1.88E-04
	Equipment Use and Misc	207,800.03	12,000,000.97	140,015,000.00	2.00E+01	1.70E+02	2.00E+00	0.00E+00	0.00E+00
	Residual Handling	2,479.15	21,279.89	NA	1.39E+01	7.42E+00	3.96E+01	1.33E-05	1.07E-03
	Total	210,438.89	12,023,290.75	140,015,000.00	3.39E+01	1.77E+02	4.16E+01	3.27E-03	2.63E-01
Alternative SV-2	Materials Production	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	0.50	6.23	NA	1.83E-04	6.46E-06	3.72E-05	1.01E-05	8.16E-04
	Transportation-Equipment	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	0.50	6.23	0	1.83E-04	6.46E-06	3.72E-05	1.01E-05	8.16E-04
Alternative SV-3	Materials Production	0.00	0.00	0	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	1.33	16.78	NA	4.94E-04	1.74E-05	1.00E-04	2.73E-05	2.20E-03
	Transportation-Equipment	0.14	1.96	NA	4.61E-05	1.88E-06	3.74E-06	7.80E-07	6.28E-05
	Equipment Use and Misc	11.33	249.66	10,906.40	1.74E-02	2.18E-02	2.13E-03	0.00E+00	0.00E+00
	Residual Handling	0.19	2.64	NA	6.21E-05	2.53E-06	5.03E-06	7.80E-07	6.28E-05
	Total	13.00	271.04	10,906.40	1.80E-02	2.18E-02	2.24E-03	2.89E-05	2.32E-03

RAC

Materials

	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	1	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	262.5	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
4.5	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.5	Decon Water	10000	gallons	
3.20	Fuel	36,000	gallons	
3.12/4.2	Clean Fill	36,324,000	lbs	Assume top soil, 1.5 ton/cy, 2000 lb/ton
3.11 / 4.1	Topsoil	10,508,000	lbs	Assume top soil, 1.5 ton/cy, 2000 lb/ton
4.8	Seed	502.59	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.8	Seed Fertilizer	4020.70	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf

Transportation-Personnel

	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1,000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
5.1	Site Superintendent	18,000	miles	360 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.2	1 QA/QC	18,000	miles	360 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.3	1 HS	9,000	miles	180 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.9/3.17	Operators (3)	27,000	miles	3 people for 360 days, 25 miles/day/person
3.10/3.18	Laborers (2)	18,000	miles	2 people for 360 days, 25 miles/day/person
2.7	Confirmation Sampling	300	miles	2 people for 10 days, 15 miles/day/person

	Transportation-equipment			
	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.5	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal
3.1	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.1	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain sawys, 100 miles round trip
3.7/3.15	Excavator	22.50	ton	
3.5/3.8	Front End Loader (2)	40.98	ton	
3.6	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

	Transportation-materials			
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	0.25	ton	Assume 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 120ftx160ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Liner frame	1.03	Ton	Assume wood, 4x4 in, (120ftx160ft pad) , density for pine 530 kg/m3
4.5	Equipment Decon Pad	5.6	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	1.0	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
2.3	Silt Fencing	0.23	Ton	Assume wood, 1 stake/3 feet. 1850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	0.13	Ton	7 10ftX 10ft rolls, geotextile 6 oz. (6 oz./sy)
4.5	Decon Water	41.70	Ton	10000 gallons
4.5	Clean Water Storage Tank	0.40	Ton	800 lbs, polyethelyene
4.5	Contaminated Decon Water Storage ˉ	0.40	Ton	800 lbs, polyethelyene
3.20	Fuel Cube	2.30	ton	
3.11/4.2	Clean Fill	18,162	Ton	
3.12 / 4.1	Top Soil	5,254	Ton	

Equipment Use

	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.7/3.15	Excavator	2,304	Hours	80% utilization, 18 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.5/3.8	Front End Loader (2)	4,608	Hours	80% utilization, 18 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.6	Dozer Compactor	2,304	Hours	80% utilization, 18 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day

Residual Handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	500	Tons	solid waste, non-hazardous
4.6	Debris Removal	100	Tons	solid waste, non-hazardous
4.5	Disposal of Decon Waste (liquid & solid)	42.70	Tons	10000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.3	Disposal of Contaminated Soils	10,875	Tons	Non-Hazardous
3.4	Disposal of Contaminated Soils	10,875	Tons	Hazardous

Transportation-residual handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	100	miles	
4.6	Debris Removal	100	miles	
4.5	Disposal of Decon Waste (liquid & solid)	100	miles	
3.3	Disposal of Contaminated Soils	400	miles	Non-hazardous
3.4	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

RAC				
Materials				
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	1	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	263	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
3.15	Geofabric	10,938	lb	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	46,000,000	lb	Compacted Clay, 23000 tons
3.16	RCRA Cap, 80-mil HDPE geomembrane	105,000	lb	0.547 lb/ft2, 87,500 SF
3.12	RCRA Cap, 1 foot gravel layer	19,502,000	lb	9751 tons
4.5	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.5	Decon Water	10,000	gallons	
3.24	Fuel	42,000	gallons	
3.13/4.2	Clean Fill	36,342,000	lbs	
3.14/4.1	Topsoil	11,666,000	lbs	
4.8	Seed	503	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.8	Seed Fertilizer	4,021	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf

Transportation-Personnel

	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
5.1	Site Superintendent	21,000	miles	420 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.2	1 QA/QC	21,000	miles	420 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.3	1 HS	10,500	miles	210 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.9/3.21	Operators (4 for 7 mo., 3 for 14 mo.)	35,000	miles	3 or 4 people, for 420 total days, 25 miles/day
3.10/3.22	Laborers (2)	42,000	miles	420 days, 50 miles/day, 4 persons
2.7	Confirmation Sampling	300	miles	2 people for 10 days, 15 miles/day/person

Transportation-equipment

	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.5	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal
3.1	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.1	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain saws, 100 miles round trip
3.7/3.19	Excavator	22.50	ton	
3.5/3.17	Front End Loader (2)	40.98	ton	
3.6/3.18	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

Transportation-materials

	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	0.25	ton	Assume 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 120ftx160ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Liner frame	1.03	Ton	Assume wood, 4x4 in, (120ftx160ft pad) , density for pine 530 kg/m3
4.9	Water for Vegetation	21	Ton	
2.3	Silt Fencing	0.23	Ton	Assume wood, 1 stake/3 feet. 1850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	0.13	Ton	7 10ftX 10ft rolls, geotextile 6 oz. (6 oz./sy)
3.15	Geofabric	5.47	Ton	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	23,000	Ton	Compacted Clay, 23000 tons
3.2	RCRA Cap, 80-mil HDPE geomembrane	52.50	Ton	0.547 lb/ft2, 87,500 SF
4.5	Equipment Decon Pad	0.4	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	0.2	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.5	Decon Water	41.70	Ton	10000 gallons
4.5	Clean Water Storage Tank	0.40	Ton	800 lbs, polyethelyene
4.5	Contaminated Decon Water Storage T	0.40	Ton	800 lbs, polyethelyene
3.25	Fuel Cube	2.30	ton	
3.13/4.2	Clean Fill	18,171	Ton	
3.14/4.1	Top Soil	5,833	Ton	

Equipment Use

	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.7/3.19	Excavator	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.7	Front End Loader (2)	5,376	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.6/3.18	Dozer/Compactor	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day

Residual Handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	500	Tons	solid waste, non-hazardous
4.6	Debris Removal	100	Tons	solid waste, non-hazardous
4.8	Disposal of Decon Waste (liquid & solid)	43	Tons	10000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.3	Disposal of Contaminated Soils	5,418	Tons	Hazardous
3.4	Disposal of Contaminated Soils	5,918	Tons	Non-hazardous

Transportation-residual handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	100	miles	100 miles
4.6	Debris Removal	100	miles	100 miles
4.8	Disposal of Decon Waste (liquid & solid)	100	miles	non-hazardous
3.3	Disposal of Non-Hazardous Soils	400	miles	
3.4	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

RAC				
Materials				
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	1	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	263	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
3.15	Geofabric	10,938	lb	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	46,000,000	lb	Compacted Clay, 23000 tons
3.16	RCRA Cap, 80-mil HDPE geomembrane	105,000	lb	0.547 lb/ft2, 87,500 SF
3.12	RCRA Cap, 1 foot gravel layer	19,502,000	lb	9751 tons
5.2	Portland Cement	1,223,600	lb	9,200 CY
4.5	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
	Decon Water	10,000	gallons	Typical use
3.24	Fuel	42,000	gallons	
3.13/4.2	Clean Fill	36,342,000	lbs	Assume top soil, 1.5 ton/cy, 2000 lb/ton
3.14/4.1	Topsoil	11,666,000	lbs	Assume top soil, 1.5 ton/cy, 2000 lb/ton
4.8	Seed	503	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.8	Seed Fertilizer	4,021	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf

Transportation-Personnel

	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
6.1	Site Superintendent	40,000	miles	800 days (5 days per week, 20 days per month), 50 miles/day, 1 person
6.2	1 QA/QC	40,000	miles	800 days (5 days per week, 20 days per month), 50 miles/day, 1 person
6.3	Oversight (H&S, Supervisor)	20,000	miles	400 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.9/3.21	Operators (4 for 7 mo., 3 for 14 mo.)	35,000	miles	3 or 4 people, for 420 total days, 25 miles/day
3.10/3.22	Laborers (2)	42,000	miles	420 days, 50 miles/day, 4 persons
2.7	Confirmation Sampling	300	miles	2 people for 10 days, 15 miles/day/person

Transportation-equipment

	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.5	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal
3.1	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.1	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain saws, 100 miles round trip
3.7/3.19	Excavator	22.50	ton	
3.5/3.17	Front End Loader (2)	40.98	ton	
3.6/3.18	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip
5.3	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

	Transportation-materials			
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	0.25	ton	Assume 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 120ftx160ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Liner frame	1.03	Ton	Assume wood, 4x4 in, (120ftx160ft pad) , density for pine 530 kg/m3
4.9	Water for Vegetation	21	Ton	
2.3	Silt Fencing	0.07	Ton	Assume wood, 1 stake/3 feet. 1850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	5.47	Ton	7 10ftX 10ft rolls, geotextile 6 oz. (6 oz./sy)
3.15	Geofabric	52.50	Ton	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	9,751	Ton	Compacted Clay, 23000 tons
3.2	RCRA Cap, 80-mil HDPE geomembrane	611.80	Ton	0.547 lb/ft2, 87,500 SF
4.5	Equipment Decon Pad	0.4	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	0.2	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.5	Decon Water	41.70	Ton	10000 gallons
4.5	Clean Water Storage Tank	0.40	Ton	800 lbs, polyethelyene
4.5	Contaminated Decon Water Storage T	0.40	Ton	800 lbs, polyethelyene
3.25	Fuel Cube	2.30	ton	
3.13/4.2	Clean Fill	18,171	Ton	
3.14/4.1	Top Soil	5,833	Ton	
5.2	Portland Cement	612	Ton	133 pounds per cubic foot

Equipment Use

	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.7/3.19	Excavator	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.7	Front End Loader (2)	5,376	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.6/3.18	Dozer/Compactor	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day
5.3	Drill Rig	3,456	Hours	80% utilization, 540 days, 8 hours/day

Residual Handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	500	Tons	solid waste, non-hazardous
4.6	Debris Removal	100	Tons	solid waste, non-hazardous
4.8	Disposal of Decon Waste (liquid & solid)	43	Tons	10000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.3	Disposal of Contaminated Soils	5,418	Tons	Hazardous
3.4	Disposal of Contaminated Soils	5,918	Tons	Non-hazardous
5.3	Drilling Spoils	4,600	Tons	

Transportation-residual handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	100	miles	100 miles
4.6	Debris Removal	100	miles	100 miles
4.8	solid)	100	miles	non-hazardous
5.3	Disposal of Spoils	100	miles	
3.3	Disposal of Non-Hazardous Soils	400	miles	
3.4	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

	RAC			
	Materials			
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	1	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	263	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
3.15	Geofabric	10,938	lb	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	46,000,000	lb	Compacted Clay, 23000 tons
3.16	RCRA Cap, 80-mil HDPE geomembrane	105,000	lb	0.547 lb/ft2, 87,500 SF
3.12	RCRA Cap, 1 foot gravel layer	19,502,000	lb	9751 tons
5.2	Portland Cement	2,167,900	lb	16,300 CY
4.5	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
	Decon Water	20,000	gallons	Typical use, double to add for solidification process
3.24	Fuel	42,000	gallons	
3.13/4.2	Clean Fill	47,780,000	lbs	2389 ton
3.14/4.1	Topsoil	1,160,000	lbs	580 ton
4.8	Seed	503	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.8	Seed Fertilizer	4,021	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf

Transportation-Personnel

	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
6.1	Site Superintendent	48,000	miles	960 days (5 days per week, 20 days per month), 50 miles/day, 1 person
6.2	1 QA/QC	48,000	miles	960 days (5 days per week, 20 days per month), 50 miles/day, 1 person
6.3	Oversight (H&S, Supervisor)	24,000	miles	480 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.9/3.21	Operators (4 for 7 mo., 3 for 14 mo.)	35,000	miles	3 or 4 people, for 420 total days, 25 miles/day
3.10/3.22	Laborers (2)	42,000	miles	420 days, 50 miles/day, 4 persons

Transportation-equipment

	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.8	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal; 4,000 gal/mo.
3.2	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.2	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain sawys, 100 miles round trip
3.7/3.19	Excavator	22.50	ton	
3.5/3.17	Front End Loader (2)	40.98	ton	
3.6/3.18	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip
5.3	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

Transportation-materials

	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	0.25	ton	Assume 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 120ftx160ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Liner frame	1.03	Ton	Assume wood, 4x4 in, (120ftx160ft pad) , density for pine 530 kg/m3
4.90	Water for Vegetation	21	Ton	
2.3	Silt Fencing	0.13	Ton	Assume wood, 1 stake/3 feet. 1850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	0.07	Ton	7 10ftX 10ft rolls, geotextile 6 oz. (6 oz./sy)
2.3	High Visibility Fencing	0.07	Ton	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
3.15	Geofabric	5.5	Ton	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	23,000	Ton	Compacted Clay, 23000 tons
3.16	RCRA Cap, 80-mil HDPE geomembrane	53	Ton	0.547 lb/ft2, 87,500 SF
3.12	RCRA Cap, 1 foot gravel layer	9,751	Ton	9751 tons
5.2	Portland Cement	1,084	Ton	16,300 CY
4.5	Equipment Decon Pad	0.2	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	10.0	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.5	Decon Water	83.40	Ton	20000 gallons
4.5	Clean Water Storage Tank	0.40	Ton	800 lbs, polyethelyene
4.5	Contaminated Decon Water Storage T	0.40	Ton	800 lbs, polyethelyene
3.25	Fuel Cube	2.30	ton	
4.10	Monitoring Wells, 2" dia. (4 new wells,	0.13	Ton	1pvc pipe, 7700 LF, 0.33 lbs/ft
3.13/4.2	Clean Fill	2,389	Ton	
3.14/4.1	Top Soil	580	Ton	

Equipment Use

	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.7/3.19	Excavator	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.7	Front End Loader (2)	5,376	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.6/3.18	Dozer/Compactor	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day
5.3	Drill Rig	4,480	Hours	80% utilization, 700 days, 8 hours/day

Residual Handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	500	Tons	solid waste, non-hazardous
4.6	Debris Removal	100	Tons	solid waste, non-hazardous
4.8	Disposal of Decon Waste (liquid & solid)	84	Tons	20000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.3	Disposal of Contaminated Soils	5,418	Tons	Hazardous
3.4	Disposal of Contaminated Soils	5,918	Tons	Non-hazardous
5.3	Drilling Spoils	8,150	Tons	

Transportation-residual handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	100	miles	100 miles
4.6	Debris Removal	100	miles	100 miles
4.8	Disposal of Decon Waste (liquid & solid)	100	miles	non-hazardous
5.3	Disposal of Spoils	100	miles	
3.3	Disposal of Non-Hazardous Soils	400	miles	
3.4	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

	RAC			
	Materials			
	Item	Quantity	Units	Comments
2.1/6.4	Electrical Power Supply	2	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	263	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
3.15	Geofabric	10,938	lb	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	46,000,000	lb	Compacted Clay, 23000 tons
3.16	RCRA Cap, 80-mil HDPE geomembrane	105,000	lb	0.547 lb/ft2, 87,500 SF
3.12	RCRA Cap, 1 foot gravel layer	19,502,000	lb	9751 tons
5.2	Portland Cement	1,223,600	lb	9,200 CY
4.5	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
	Decon Water	20,000	gallons	Typical use, double to add for solidification process
3.24	Fuel	42,000	gallons	
3.13/4.2	Clean Fill	47,780,000	lbs	2389 ton
3.14/4.1	Topsoil	1,160,000	lbs	580 ton
4.8	Seed	503	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.8	Seed Fertilizer	4,021	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf
7.1/7.3	Air Sparge/Solvent Injection Wells, 1" dia.	2082	lbs	1 inch dia, PVC,6680 LF, 0.33 lbs/ft
7.1/7.3	Air Sparge Well Head	1015	lb	203 wellheads, assume 5 lb per wellhead, assume mostly PVC
7.2/7.4	Solvent	7,920,000	lb	1,200,000 gallons - use ethanol
8.1	Product Recovery Wells, 1" diam.	416	lbs	1 inch dia, PVC,1260 LF, 0.33 lbs/ft
8.2	Product Recovery Well Head	105	lb	21 wellheads, assume 5 lb per wellhead, assume mostly PVC

8.9	Waste Oil Tank	4000	lbs	2 each, 10,000 gallon at 2 ton ea.
8.3/8.7/9.2	Piping, 1" dia. HDPE	440	lbs	1 inch dia, sch 40 HDPE, 2000 LF, 0.22 lbs/ft
6.1	Building, floor	58,000	lbs	Assume block building with foundation, 800 ft2, consider only concrete, 6 inch thick. 145 lb/ft2
6.1	Building, walls	36,000	lbs	Assume 12 ft high walls, 40 LF. 900 blocks, 40 lb/ea
6.1	Building, walls	1,620	lbs	Calculate mortar needed for 900 blocks, 27 bags, 60 lbs/ea
6.1	Building,sand for walls	6,300	lbs	Calculate sand needed for 900 blocks, 3.15 tons

Transportation-Personnel

	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
6.1	Site Superintendent	52,000	miles	1,040 days (5 days per week, 20 days per month), 50 miles/day, 1 person
6.2	1 QA/QC	52,000	miles	1,040 days (5 days per week, 20 days per month), 50 miles/day, 1 person
6.3	Oversight (H&S, Supervisor)	26,000	miles	520 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.9/3.21	Operators (4 for 7 mo., 3 for 14 mo.)	35,000	miles	3 or 4 people, for 420 total days, 25 miles/day
3.10/3.22	Laborers (2)	42,000	miles	420 days, 50 miles/day, 4 persons

Transportation-equipment

	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.8	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal; 4,000 gal/mo.
3.2	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.2	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain sawys, 100 miles round trip
3.7/3.19	Excavator	22.50	ton	
3.5/3.17	Front End Loader (2)	40.98	ton	
3.6/3.18	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip
5.3	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

	Transportation-materials			
	Item	Quantity	Units	Comments
2.1/6.4	Electrical Power Supply	0.50	ton	1 ea at 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	1.03	Ton	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	21	Ton	
2.3	Silt Fencing	0.13	Ton	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	0.07	Ton	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	0.07	Ton	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
3.15	Geofabric	5.5	Ton	262500 SF, 6 oz./SY
3.11	RCRA Cap, Compacted Clay	23,000	Ton	Compacted Clay, 23000 tons
3.16	RCRA Cap, 80-mil HDPE geomembrane	53	Ton	0.547 lb/ft2, 87,500 SF
3.12	RCRA Cap, 1 foot gravel layer	9,751	Ton	9751 tons
5.2	Portland Cement	611.8	Ton	9,200 CY
4.5	Equipment Decon Pad	0.4	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.5	Equipment Decon Pad	0.2	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
	Decon Water	83.4	Ton	Typical use, double to add for solidification process
3.25	Fuel Cube	2.30	ton	
3.13/4.2	Clean Fill	2,389	Ton	
3.14/4.1	Top Soil	580	Ton	
4.8	Seed	0.3	Ton	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.8	Seed Fertilizer	2.0	Ton	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf
7.1/7.3	Air Sparge/Solvent Injection Wells, 1" dia.	1.0	Ton	1 inch dia, PVC,6680 LF, 0.33 lbs/ft
7.1/7.3	Air Sparge Well Head	0.5	Ton	203 wellheads, assume 5 lb per wellhead, assume mostly PVC
7.2/7.4	Solvent	26,136	Ton	1,200,000 gallons - use ethanol 6.6 lbs/gal
8.1	Product Recovery Wells, 1" diam.	0.2	Ton	1 inch dia, PVC,1260 LF, 0.33 lbs/ft
8.2	Product Recovery Well Head	0.1	Ton	21 wellheads, assume 5 lb per wellhead, assume mostly PVC
8.9	Waste Oil Tank	2.0	Ton	2 each, 10,000 gallon at 2 ton ea.
8.3/8.7/9.2	Piping, 1" dia. HDPE	0.2	Ton	1 inch dia, sch 40 HDPE, 2000 LF, 0.22 lbs/ft
6.1	Building, floor	29.0	Ton	Assume block building with foundation, 800 ft2, consider only concrete, 6 inch thick. 145 lb/ft2

6.1	Building, walls	18.0	Ton	Assume 12 ft high walls, 40 LF. 900 blocks, 40 lb/ea
6.1	Building, walls	0.8	Ton	Calculate mortar needed for 900 blocks, 27 bags, 60 lbs/ea
6.1	Building,sand for walls	3.2	Ton	Calculate sand needed for 900 blocks, 3.15 tons

Equipment Use

	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.7/3.19	Excavator	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.7	Front End Loader (2)	5,376	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.6/3.18	Dozer/Compactor	2,688	Hours	80% utilization, 21 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day
5.3	Drill Rig	3,456	Hours	80% utilization, 540 days, 8 hours/day

Residual Handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	500	Tons	solid waste, non-hazardous
4.6	Debris Removal	100	Tons	solid waste, non-hazardous
4.8	Disposal of Decon Waste (liquid & solid)	84	Tons	20000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.3	Disposal of Contaminated Soils	5,418	Tons	Hazardous
3.4	Disposal of Contaminated Soils	5,918	Tons	Non-hazardous
5.3	Drilling Spoils	4,600	Tons	

Transportation-residual handling

	Item	Quantity	Units	Comments
3.2	Concrete Disposal	100	miles	100 miles
4.6	Debris Removal	100	miles	100 miles
4.8	Disposal of Decon Waste (liquid & solid)	100	miles	non-hazardous
5.3	Disposal of Spoils	100	miles	
3.3	Disposal of Non-Hazardous Soils	400	miles	
3.4	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

RAC

Materials

	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	1	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.9	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	263	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
4.8	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.8	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.8	Decon Water	10000	gallons	
3.29	Fuel	84,000	gallons	
3.9/3.21/ 4.2	Clean Fill	36,324,000	lbs	Assume top soil, 1.5 ton/cy, 2000 lb/ton
4.1	Topsoil	10,508,000	lbs	Assume top soil, 1.5 ton/cy, 2000 lb/ton
4.11	Seed	503	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.11	Seed Fertilizer	4021	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf
3.4/3.17	Sheet Pile	129,740,292	lbs	NZ Hot Rolled Steel Sheet Pile, 3186 lb/CY
4.4	Crushed Concrete	35,100	lbs	2700 lb/CY
4.5	Asphalt	25,448	lbs	145 lb/CY

	Transportation-Personnel			
	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1,000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
5.1	Site Superintendent	42,000	miles	840 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.2	1 QA/QC	42,000	miles	840 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.3	1 HS	21,000	miles	420 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.14/3.26	Operators (4)	84,000	miles	4 people for 840 days, 25 miles/day/person
3.15/3.27	Laborers (2)	42,000	miles	2 people for 840 days, 25 miles/day/person
2.7	Confirmation Sampling	300	miles	2 people for 10 days, 15 miles/day/person

	Transportation-equipment			
	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.5	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal
3.1	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.1	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain sawys, 100 miles round trip
3.12/3.24	Excavator	22.50	ton	
3.10/3.22	Front End Loader (2)	40.98	ton	
3.11/3.23	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

	Transportation-materials			
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	0.25	ton	Assume 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 120ftx160ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Liner frame	1.03	Ton	Assume wood, 4x4 in, (120ftx160ft pad) , density for pine 530 kg/m3
4.8	Equipment Decon Pad	0.4	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.8	Equipment Decon Pad	0.2	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
2.3	Silt Fencing	0.23	Ton	Assume wood, 1 stake/3 feet. 1850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	0.13	Ton	7 10ftX 10ft rolls, geotextile 6 oz. (6 oz./sy)
4.8	Decon Water	41.70	Ton	10000 gallons
4.8	Clean Water Storage Tank	0.40	Ton	800 lbs, polyethelyene
4.8	Contaminated Decon Water Storage ⁻	0.40	Ton	800 lbs, polyethelyene
3.30	Fuel Cube	2.30	ton	
4.4	Crushed Concrete	18	ton	2700 lb/CY
4.5	Asphalt	13	ton	145 lb/CY
4.11	Seed	0.25	ton	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.11	Seed Fertilizer	2.0	ton	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf
3.4/3.17	Sheet Pile	64,870	tons	NZ Hot Rolled Steel Sheet Pile, 3186 lb/CY
3.9/3.21/ 4.2	Clean Fill	18,162	Ton	
4.1	Top Soil	5,254	Ton	

	Equipment Use			
	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.12/3.24	Excavator	5,376	Hours	80% utilization, 42 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.10/3.22	Front End Loader (2)	10,752	Hours	80% utilization, 42 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.11/3.23	Dozer Compactor	5,376	Hours	80% utilization, 42 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day

	Residual Handling			
	Item	Quantity	Units	Comments
3.3	Concrete Disposal	1800	Tons	solid waste, non-hazardous
4.9	Debris Removal	100	Tons	solid waste, non-hazardous
4.8	Disposal of Decon Waste (liquid & solid)	42.70	Tons	10000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.7/3.19	Disposal of Contaminated Soils	87,556	Tons	Non-Hazardous
3.6/3.19	Disposal of Contaminated Soils	21,889	Tons	Hazardous

	Transportation-residual handling			
	Item	Quantity	Units	Comments
3.3	Concrete Disposal	100	miles	
4.9	Debris Removal	100	miles	
4.8	Disposal of Decon Waste (liquid & solid)	100	miles	
3.7/3.19	Disposal of Contaminated Soils	400	miles	Non-hazardous
3.6/3.19	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

	RAC			
	Materials			
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	1	ea	Assume electrical is reused after use. Only transportation of equipment is considered.
2.5	Soil Staging Pad Liner (bottom)	1,320	lb	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	11,208	lb	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Frame	2,059	lb	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3
4.12	Water for Vegetation	5,000	gallons	
2.3	Silt Fencing	454	lb	Assume wood, 1 stake/3 feet. 1,850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	263	lb	1,850 linear ft (7X 300 ft rolls), 36 in, assume 6 oz. geotextile (6 oz./sy)
2.3	High Visibility Fencing	140	lb	1,300 Linear FT (3 sides fencing), each roll 4' X 100', 13 rolls
4.8	Equipment Decon Pad	730	lb	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.8	Equipment Decon Pad	368	lb	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
4.8	Decon Water	10000	gallons	
3.29	Fuel	150,000	gallons	
3.9/3.21/ 4.2	Clean Fill	435,564,000	lbs	217782 tons
4.1	Topsoil	756,000	lbs	378 tons
4.11	Seed	503	lbs	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.11	Seed Fertilizer	4021	lbs	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf
3.4/3.17	Sheet Pile	155,623,356	lbs	NZ Hot Rolled Steel Sheet Pile, 3186 lb/CY
4.4	Crushed Concrete	35,100	lbs	2700 lb/CY
4.5	Asphalt	25,448	lbs	145 lb/CY

	Transportation-Personnel			
	Item	Quantity	Units	Comments
1.3	Sample Collection - Pre-Excavation - Geologist	600	miles	2 people for 20 days, 15 miles/day/person
1.3	Drilling Subcontractor	500	miles	1 person for 20 days, 25 miles/day/person
2.3	Site Prep	1,000	miles	2 people for 10 + 10 days, 25 miles/day/person
2.2	Underground Utility Clearance	500	miles	5 days, 50 miles/day, 2 people
5.1	Site Superintendent	75,000	miles	1500 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.2	1 QA/QC	75,000	miles	1500 days (5 days per week, 20 days per month), 50 miles/day, 1 person
5.3	1 HS	37,500	miles	750 days (5 days per week, 20 days per month), 50 miles/day, 1 person
3.1	Site clearing crew	1,250	miles	5 day, 50 miles/day, 5 people
3.14/3.26	Operators (4)	150,000	miles	4 people for 1500 days, 25 miles/day/person
3.15/3.27	Laborers (2)	75,000	miles	2 people for 1500 days, 25 miles/day/person
2.7	Confirmation Sampling	300	miles	2 people for 10 days, 15 miles/day/person

	Transportation-equipment			
	Item	Quantity	Units	Comments
2.1	Office Trailer	6	Ton	Assume 3 tons, 2 trips
2.1	Porta-john	0.9	Ton	Assume Dropoff/Pickup and Service, 12 trips (4/mo./3 mo.
4.5	Water Tank Truck	27.3	Ton	54,600 lb gross weight, capacity = 4,000 gal
3.1	Wood Chipper (100 HP)	2.85	ton	1 wood chipper, 2.85 tons per woodchipper, 100 miles round trip
3.1	Chain saw (2) 36 in long, gas	0.02	ton	16.5 lb per chain saw, 2 chain sawys, 100 miles round trip
3.12/3.24	Excavator	22.50	ton	
3.10/3.22	Front End Loader (2)	40.98	ton	
3.11/3.23	Dozer/Compactor	15.7	ton	net 125 HP dozer crawler
1.2	Drill Rig Mobilization/Demobilization	3.1	Ton	1 drill rig, 6100 lb, 100 miles round trip

	Transportation-materials			
	Item	Quantity	Units	Comments
2.1	Electrical Power Supply	0.25	ton	Assume 500 lbs
2.5	Soil Staging Pad Liner (bottom)	0.67	TON	HDPE Liner, 10 oz/sy, 16 oz/lb, 160ftX120ft
2.5	Soil Staging Pad Liner (top)	5.60	Ton	assume HDPE, Assume 120ftx160ft, 3 mm thick, 0.95 g/cm3
2.5	Soil Staging Pad Liner frame	1.03	Ton	Assume wood, 4x4 in, (120ftx160ft pad) , density for pine 530 kg/m3
4.8	Equipment Decon Pad	0.4	Ton	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3
4.8	Equipment Decon Pad	0.2	Ton	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3
2.3	Silt Fencing	0.23	Ton	Assume wood, 1 stake/3 feet. 1850 linear ft, 5ftX1"X2" stakes, balsa wood (170 kg/m^3)
2.3	Silt Fencing	0.13	Ton	7 10ftX 10ft rolls, geotextile 6 oz. (6 oz./sy)
4.8	Decon Water	41.70	Ton	10000 gallons
4.8	Clean Water Storage Tank	0.40	Ton	800 lbs, polyethelyene
4.8	Contaminated Decon Water Storage ⁻	0.40	Ton	800 lbs, polyethelyene
3.30	Fuel Cube	2.30	ton	
4.4	Crushed Concrete	18	ton	2700 lb/CY
4.5	Asphalt	13	ton	145 lb/CY
4.11	Seed	0.25	ton	Assume fertilizer, 1.035 msf (thousand square feet), 3 lb of seed per 1.2 msf, 968 sy, 200 msf (Site 1)
4.11	Seed Fertilizer	2.0	ton	1.035 msf + 200 msf (Site 1), assume fertilizer, assume 20 lb per msf
3.4/3.17	Sheet Pile	77,812	tons	NZ Hot Rolled Steel Sheet Pile, 3186 lb/CY
3.9/3.21/ 4.2	Clean Fill	217,782	Ton	
4.1	Top Soil	378	Ton	

	Equipment Use			
	Item	Quantity	Units	Comments
3.1	Wood chipper (100 HP)	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.1	Chain saw (2) 36 in long, gas	450	Hours	1 acre RSM 2012 = 100 hours; 31 11 10.10 0020
3.12/3.24	Excavator	9,600	Hours	80% utilization, 75 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.10/3.22	Front End Loader (2)	19,200	Hours	80% utilization, 75 mo., 5 days/wk, 4 wk/mo., 8 hours/day
3.11/3.23	Dozer Compactor	9,600	Hours	80% utilization, 75 mo., 5 days/wk, 4 wk/mo., 8 hours/day
1.2/2.7	Drill Rig	192	Hours	80% utilization, 30 days, 8 hours/day

	Residual Handling			
	Item	Quantity	Units	Comments
3.3	Concrete Disposal	1800	Tons	solid waste, non-hazardous
4.9	Debris Removal	100	Tons	solid waste, non-hazardous
4.8	Disposal of Decon Waste (liquid & solid)	42.70	Tons	10000 gallons, 8.34 lbs/gal; + 1 ton debris (X.24)
3.7/3.19	Disposal of Contaminated Soils	194,220	Tons	Non-Hazardous
3.6/3.19	Disposal of Contaminated Soils	21,780	Tons	Hazardous

	Transportation-residual handling			
	Item	Quantity	Units	Comments
3.3	Concrete Disposal	100	miles	
4.9	Debris Removal	100	miles	
4.8	Disposal of Decon Waste (liquid & solid)	100	miles	
3.7/3.19	Disposal of Contaminated Soils	400	miles	Non-hazardous
3.6/3.19	Disposal of Contaminated Soils	400	miles	hazardous waste transportation

Alternative SV2, SVE Monitoring
Soils

Materials			
Item	Quantity	Units	Comments
Transportation-Personnel			
Item	Quantity	Units	Comments
Site Labor - Initial Sampling	1300	miles	1 person, 1 day per week, 52 weeks, 25 miles/day
Transportation-equipment			
Item	Quantity	Units	Comments
Transportation-materials			
Item	Quantity	Units	Comments
Equipment Use			
Item	Quantity	Units	Comments
Residual Handling			
Item	Quantity	Units	Comments
Disposal of Decon Waste (liquid & solid)	0.00	Tons	8.34 lbs/gal
Transportation-residual handling			
Item	Quantity	Units	Comments
Disposal of Decon Waste (liquid &	0.00	miles	100 miles

	Item	Quantity	Units	Comments
	Materials			
	Item	Quantity	Units	Comments
	Temporary Equipment Decon Pad	1,471	lb	Assume wood, 4x4 in, (20ftx20ft pad), density for pine 530 kg/m3
	Decon Water	5000	gallons	Typical use
1.1	SVE wells, 2" dia. (6 new wells at 50')	216	lbs	2 inch dia, PVC, 0.72 lbs/ft
1.2	SVE injection piping	495	lbs	1 inch dia, sch 40 HDPE, 0.33 lbs/ft, 1500 LFT
1.1	Monitoring Wells Head Completion	30	lb	6 wellheads, assume 5 lb per wellhead, assume mostly PVC
	Transportation-Personnel			
	Item	Quantity	Units	Comments
1.6	1 QA/QC and 1 geologist	1500.0	miles	30 days, 50 miles/day, 1 person
1.5	Operator	1500.0	miles	30 days, 50 miles/day, 1 person
1.1	Drilling sub	500	miles	1 person for 10 days, 50 miles/day/person
	Transportation-equipment			
	Item	Quantity	Units	Comments
1.1	Drill Rig Mob/Demob	3.05	Ton	1 drill rig, 6100 lb, 100 miles round trip
	Transportation-materials			
	Item	Quantity	Units	Comments
	Decon water	20.85	ton	5000 gallons
	Temporary Equipment Decon Pad	0.74	Ton	Assume wood, 4x4 in, (20ftx20ft pad), density for pine 530 kg/m3
1.1	SVE Wells, 2" dia.	0.11	Ton	2 inch dia, PVC, 0.72 lbs/ft
1.2	SVE injection piping	0.25	Ton	
1.1	Well Heads	0.02	Ton	
	Equipment Use			
	Item	Quantity	Units	Comments
1.1	Drill Rig Use	64	Hours	10 days, 8 hrs, 80% utilty
1.4	Blower use	8640	hours	
	Residual Handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	20.85	Tons	5000 gallons, 8.34 lbs/gal
	Transportation-residual handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	100.00	miles	100 miles

Alternative G2

	Item	Quantity	Units	Comments
	RI			
	RAC			
	Materials			
	Item	Quantity	Units	Comments
	Temporary Equipment Decon Pad	1,471	lb	Assume wood, 4x4 in, (20ftx20ft pad), density for pine 530 kg/m3
	Decon Water	5000	gallons	Typical use
2.1	Monitoring Wells, 2" dia.	648	lbs	2 inch dia, PVC, 0.72 lbs/ft, 900 FT
	Transportation-Personnel			
	Item	Quantity	Units	Comments
	Underground Utility Clearance	250	miles	5 days, 50 miles/day, 1 person
2.3	Driller	1000	miles	20 days, 50 miles/day, 1 person
1.4	Field Labor	500	miles	10 day, 50 miles/day, 1 person
2.2	Geologist	1000	miles	20 day, 50 miles/day, 1 person
	Transportation-equipment			
	Item	Quantity	Units	Comments
2.3	Drill Rig Mob/Demob	3.05	Ton	1 drill rig, 6100 lb, 100 miles round trip
	Transportation-materials			
	Item	Quantity	Units	Comments
2.4	Temporary Equipment Decon Pad	0.74	Ton	Assume wood, 4x4 in, (20ftx20ft pad) 80 ft of timber, density for pine 530 kg/m3
	Decon water	20.85	ton	5000 gallons
2.1	Monitoring Wells, 2" dia.	0.324	Ton	2 inch dia, PVC, 0.72 lbs/ft
	Equipment Use			
	Item	Quantity	Units	Comments
2.3	Drill Rig Use	128	Hours	20 day, 8 hrs, 80% utilty
	Residual Handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	20.85	Tons	5000 gallons, 8.34 lbs/gal
	Transportation-residual handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	100.00	miles	100 miles

Alternative G-3A

	RI			
	RAC			
	Materials			
	Item	Quantity	Units	Comments
	Temporary Equipment Decon Pad	1,471	lb	Assume wood, 4x4 in, (20ftx20ft pad), density for pine 530 kg/m3
	Decon Water	5000	gallons	Typical use
2.1	Monitoring Wells, 2" dia.	648	lbs	2 inch dia, PVC, 0.72 lbs/ft, 900 FT
3.1	Granular Activated Carbon	40000	lbs	8 5,000 pound units
	Transportation-Personnel			
	Item	Quantity	Units	Comments
	Underground Utility Clearance	250	miles	5 days, 50 miles/day, 1 person
2.3	Driller	1000	miles	20 days, 50 miles/day, 1 person
1.4	Field Labor	500	miles	10 day, 50 miles/day, 1 person
2.2	Geologist	1000	miles	20 day, 50 miles/day, 1 person
3.2	Field Labor - GAC Install	1000	miles	10 day, 50 miles/day, 2 people
	Transportation-equipment			
	Item	Quantity	Units	Comments
2.3	Drill Rig Mob/Demob	3.05	Ton	1 drill rig, 6100 lb, 100 miles round trip
	Transportation-materials			
	Item	Quantity	Units	Comments
2.4	Temporary Equipment Decon Pad	0.32	Ton	Assume wood, 4x4 in, (20ftx20ft pad) 80 ft of timber, density for pine 530 kg/m3
	Decon water	20.85	ton	5000 gallons
2.1	Monitoring Wells, 2" dia.	0	Ton	2 inch dia, PVC, 0.72 lbs/ft
3.2	Granular Activated Carbon	20	Ton	liquid phase granular activated carbon
	Equipment Use			
	Item	Quantity	Units	Comments
2.3	Drill Rig Use	128	Hours	20 day, 8 hrs, 80% utilty
	Residual Handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	20.85	Tons	5000 gallons, 8.34 lbs/gal
	Transportation-residual handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	100.00	miles	100 miles

Alternative G-3B

RI

RAC

	Materials			
	Item	Quantity	Units	Comments
	Temporary Equipment Decon Pad	1,471	lb	Assume wood, 4x4 in, (20ftx20ft pad), density for pine 530 kg/m3
	Decon Water	5000	gallons	Typical use
2.1	Monitoring Wells, 2" dia.	648	lbs	2 inch dia, PVC, 0.72 lbs/ft, 900 FT
3.1	Ion Exchange Resin	19,500	lbs	1 Unit Each 19,500 lbs
	Transportation-Personnel			
	Item	Quantity	Units	Comments
	Underground Utility Clearance	250	miles	5 days, 50 miles/day, 1 person
2.3	Driller	1000	miles	20 days, 50 miles/day, 1 person
1.4	Field Labor	500	miles	10 day, 50 miles/day, 1 person
2.2	Geologist	1000	miles	20 day, 50 miles/day, 1 person
3.2	Field Labor - Ion Exchange Install	1000	miles	10 day, 50 miles/day, 2 people
	Transportation-equipment			
	Item	Quantity	Units	Comments
2.3	Drill Rig Mob/Demob	3.05	Ton	1 drill rig, 6100 lb, 100 miles round trip
	Transportation-materials			
	Item	Quantity	Units	Comments
2.4	Temporary Equipment Decon Pad	0.32	Ton	Assume wood, 4x4 in, (20ftx20ft pad) 80 ft of timber, density for pine 530 kg/m3
	Decon water	20.85	ton	5000 gallons
2.1	Monitoring Wells, 2" dia.	0.32	Ton	2 inch dia, PVC, 0.72 lbs/ft
3.2	Ion Exchange Resin	10	Ton	1 Unit Each 19,500 lbs
	Equipment Use			
	Item	Quantity	Units	Comments
2.3	Drill Rig Use	128	Hours	20 day, 8 hrs, 80% utilty
	Residual Handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	20.85	Tons	5000 gallons, 8.34 lbs/gal
	Transportation-residual handling			
	Item	Quantity	Units	Comments
	Disposal of Decon Waste (liquid & solid)	100.00	miles	100 miles

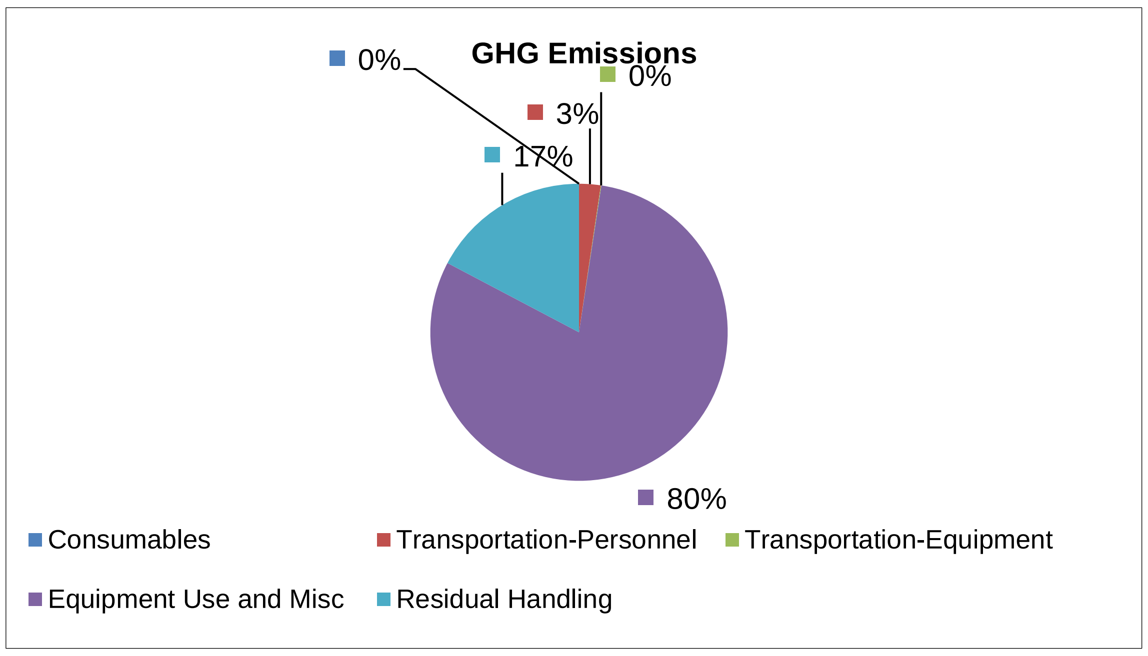
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								Tonnes				MWhr	gal x 1000
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	Clean Fill	Soil	assume top soil	36,324,000.00	lbs	378.89	378.89	0.00	0.00	0.00	0.00	0.00	10012.60	0.00
RAC	Top Soil	Soil	assume top soil	10,508,000.00	lbs	109.61	109.61	0.00	0.00	0.00	0.00	0.00	2896.50	0.00
RAC	High Visibility Fencing	HDPE	geotextile, use HDPE, 6 oz/sy	140.00	lbs	0.31	0.17	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,021.00	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.89	1.82
	Subtotal					**524.03**	**509.65**	**0.04**	**0.12**	**0.00**	**0.07**	**0.01**	**13178.78**	**6.75**
	Construction Equipment								Tonnes				MWhr	gal x 1000
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		2,304.00	hrs	404.95	404.95	0.00	0.00	2.78	0.75	0.23	2008.56	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		4,608.00	hrs	93.50	93.50	0.00	0.00	0.86	0.17	0.11	394.20	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	2,304.00	hrs	138.16	138.16	0.00	0.00	0.92	0.25	0.10	741.48	
RAC	Paver	Paver, 100 HP (diesel)	use 100 (was 130 HP)	1,184.00	hrs	42.92	42.62	0.00	0.00	0.30	0.07	0.04	144.70	
	Subtotal					**703.04**	**702.67**	**0.00**	**0.01**	**5.04**	**1.25**	**0.50**	**3402.55**	**0**
	Operating Consumption						Tonnes						MWhr	gal x 1000
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**1,227**	**1,212**	**0.04**	**0.12**	**5.04**	**1.32**	**0.51**	**16,581**	**7**

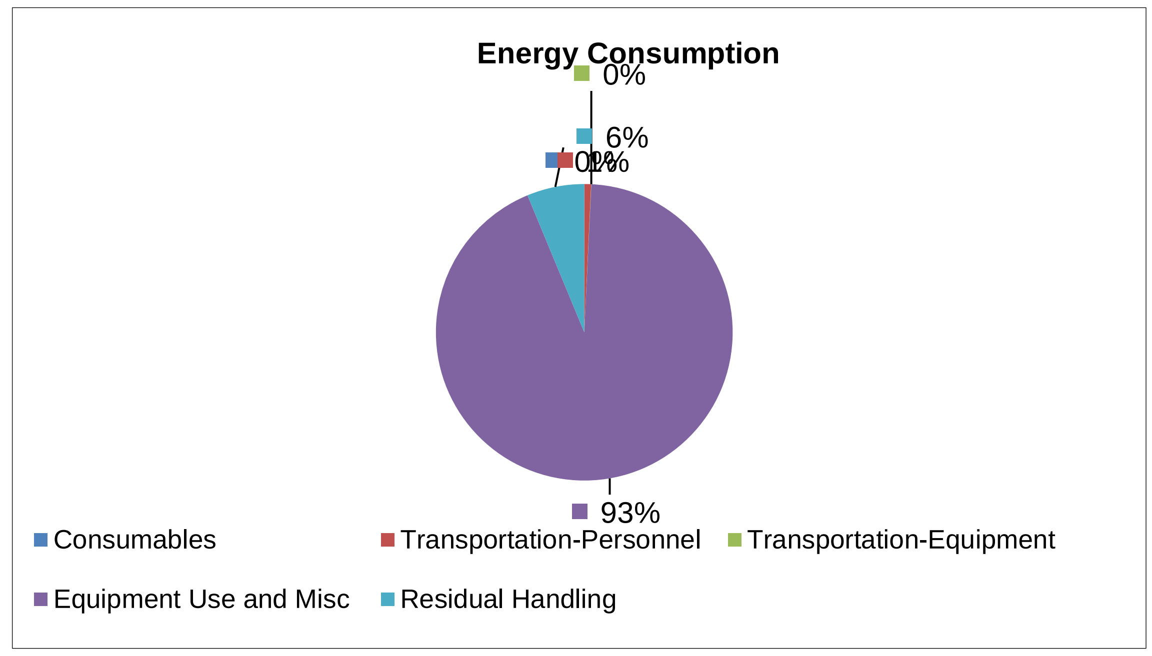
Alternative 1

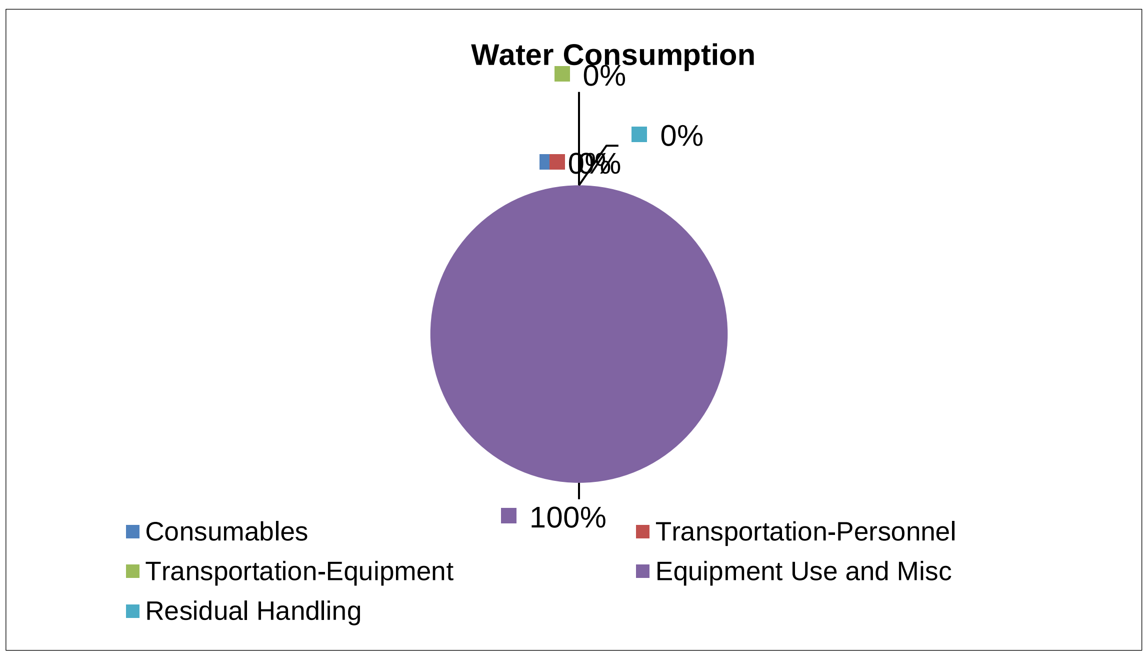
Values Input into SiteWise as "Other"

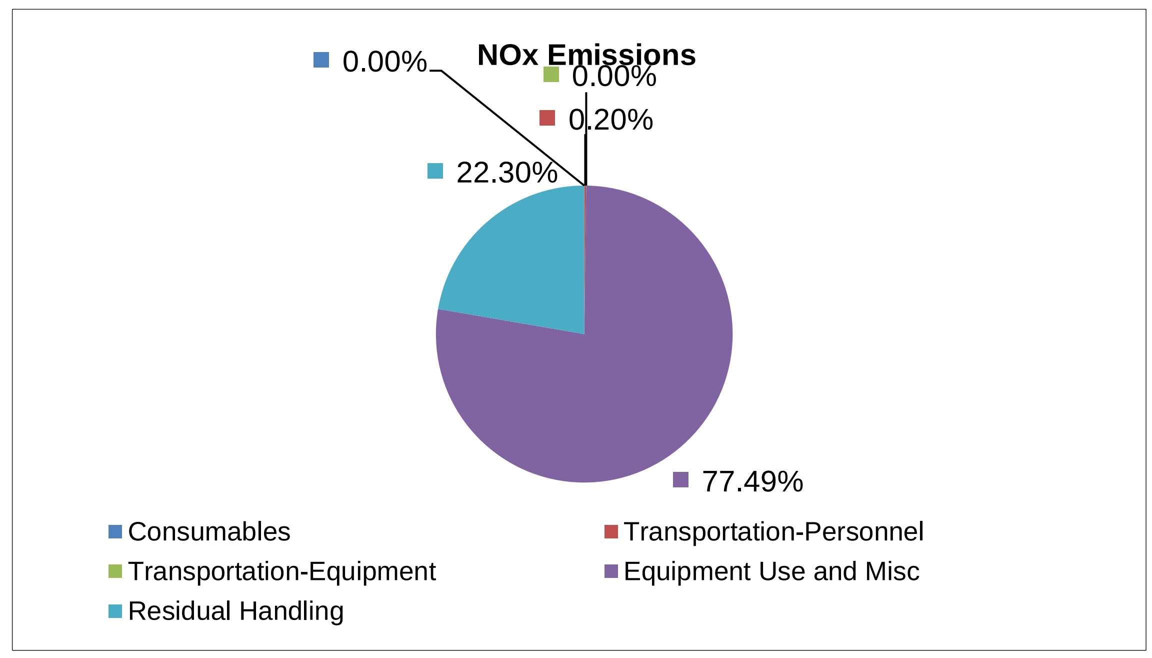
Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	1,227.07	1,212.32	12.16	2.58	5.04	1.32	0.51	56,575.51	6,746.23
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

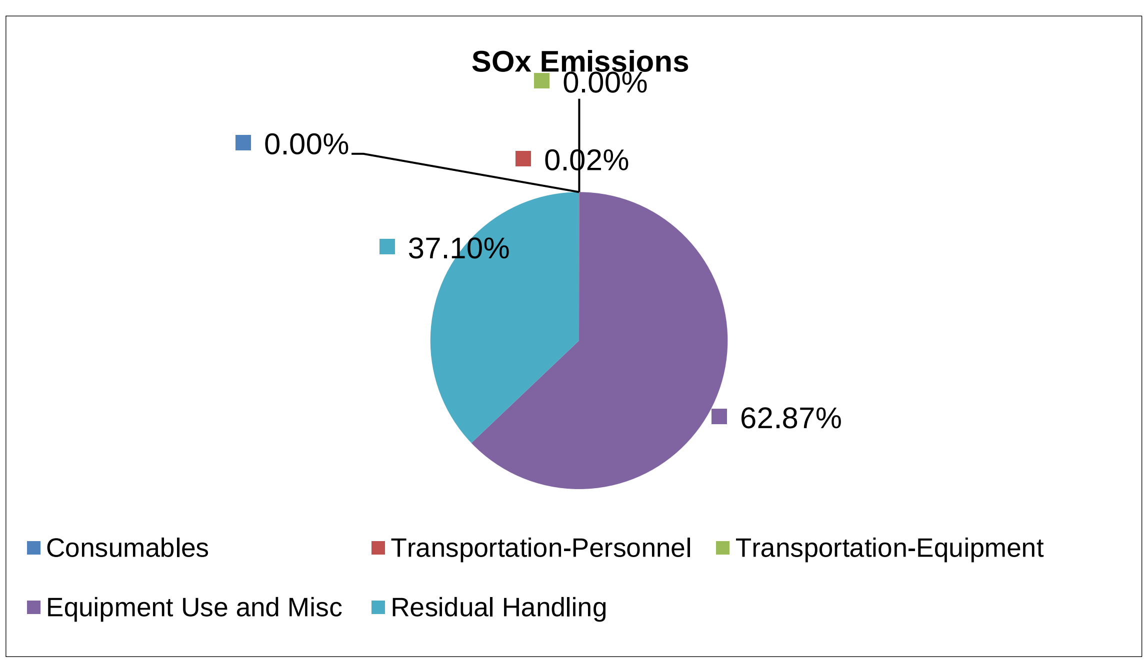
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

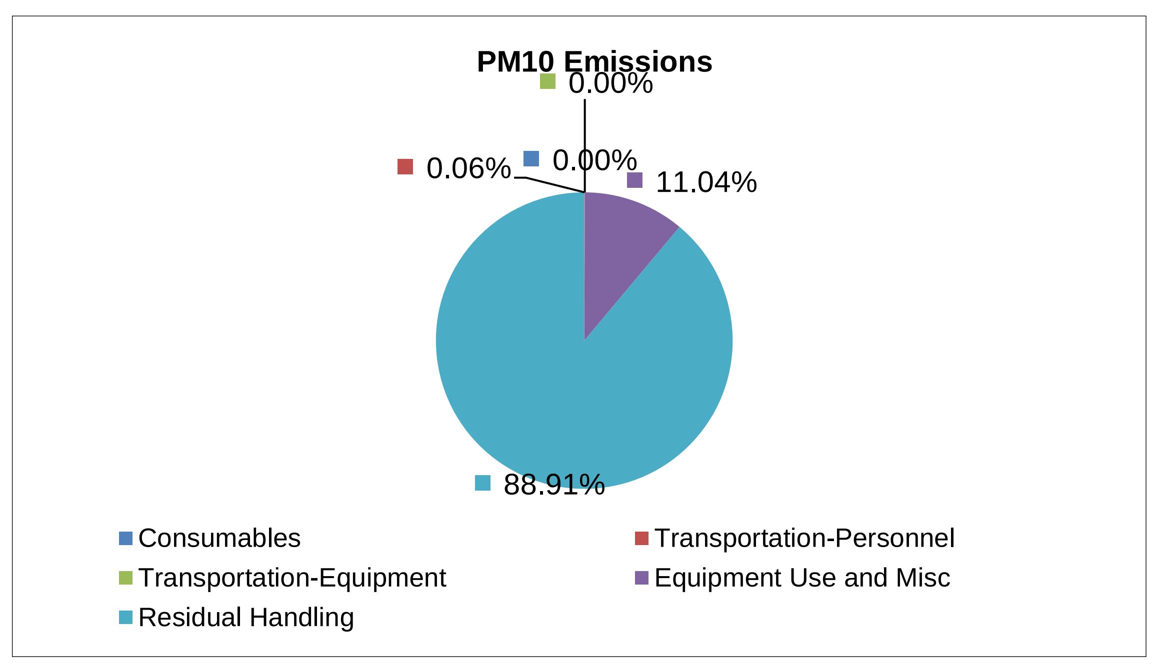

GHG Emissions
0%
0%
3%
17%
80%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

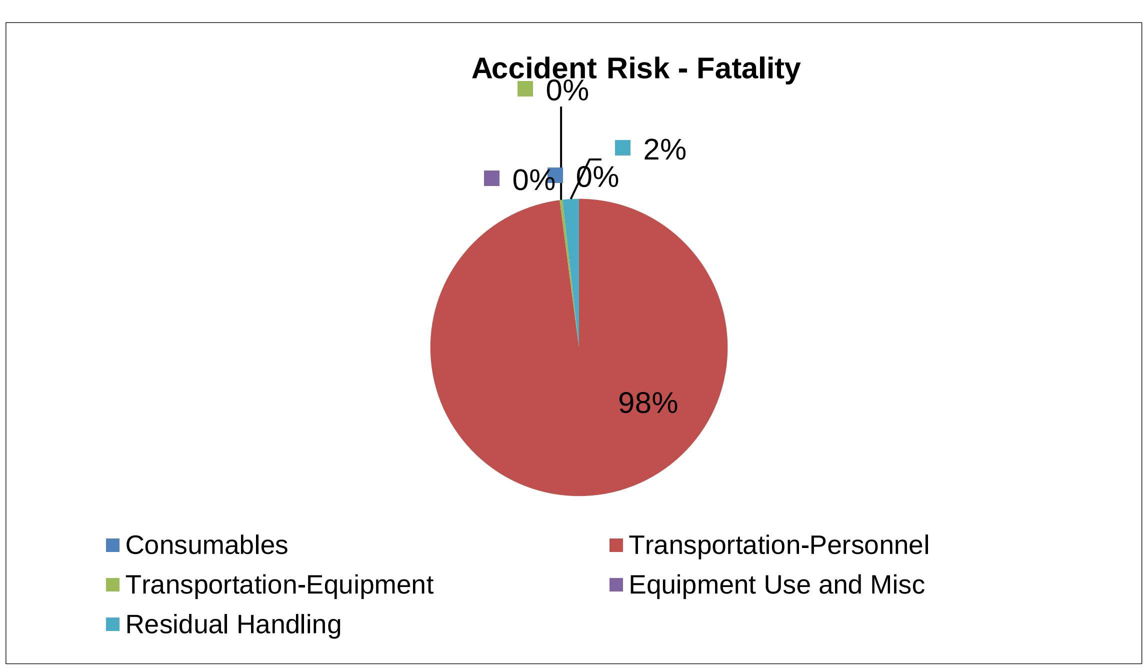

Energy Consumption
0%
6%
93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

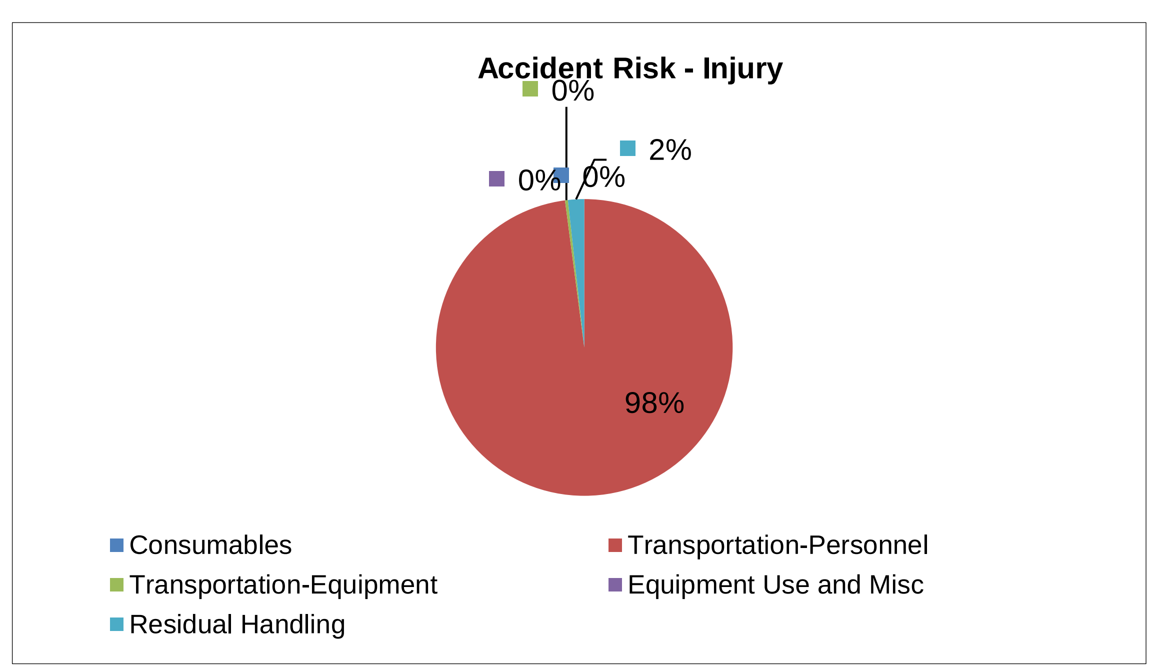

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.00%
0.20%
22.30%
77.49%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
0.00%
0.02%
37.10%
62.87%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
0.06%
0.00%
11.04%
88.91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
2%
0%
0%
98%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

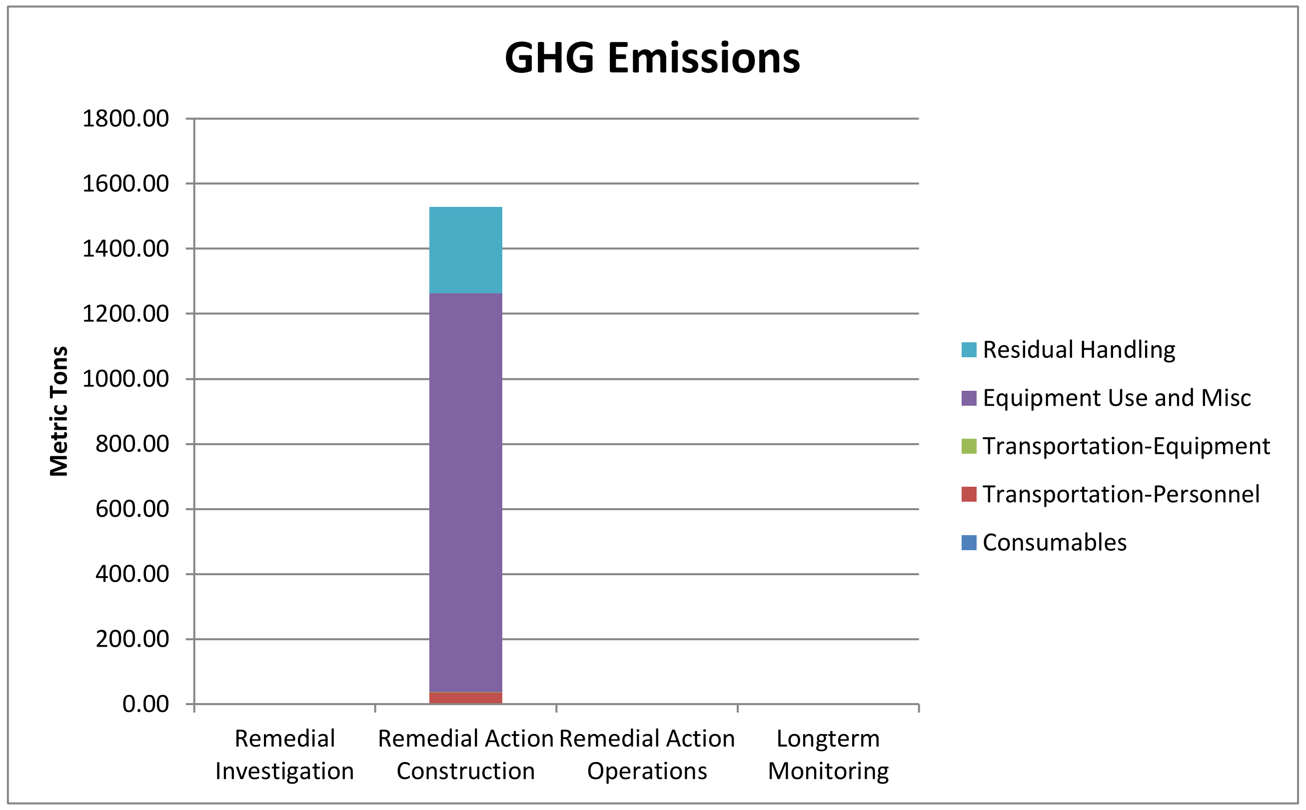

Accident Risk - Injury
0%
2%
0%
0%
98%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

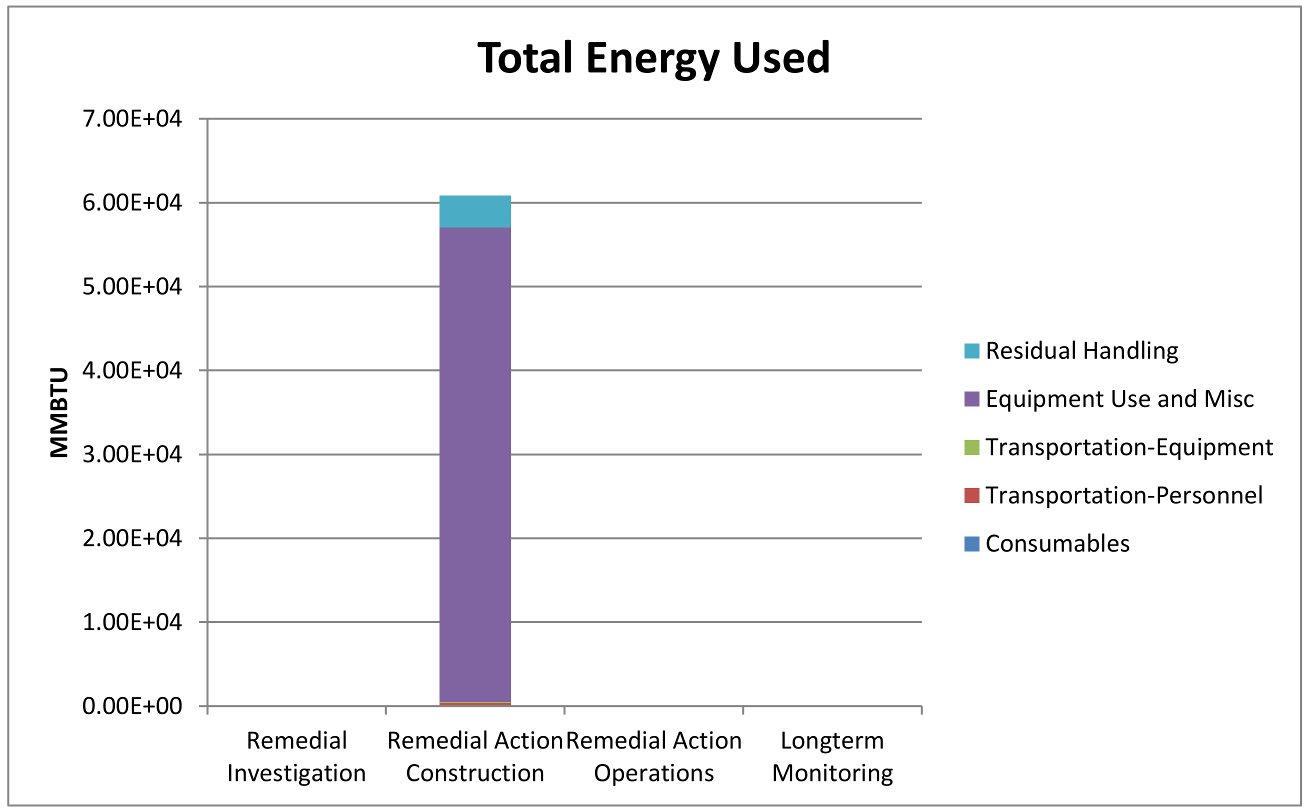
Sustainable Remediation - Environmental Footprint Summary

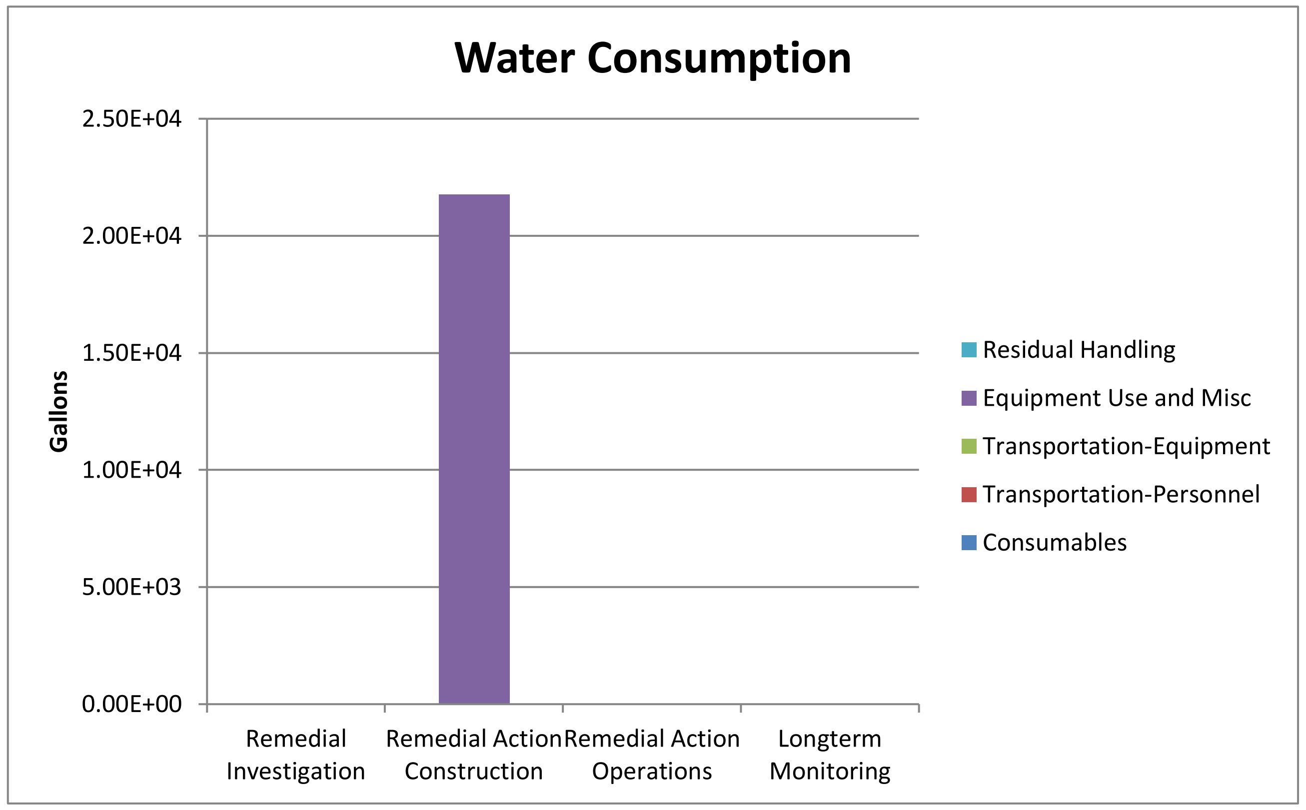
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	35.88	4.5E+02	NA	1.3E-02	4.7E-04	2.7E-03	7.3E-04	5.9E-02
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	1,227.10	5.7E+04	2.2E+04	5.0E+00	1.3E+00	5.1E-01	0.0E+00	0.0E+00
	Residual Handling	264.03	3.8E+03	NA	1.5E+00	7.8E-01	4.1E+00	1.3E-05	1.1E-03
	Sub-Total	1,527.93	6.08E+04	2.17E+04	6.51E+00	2.09E+00	4.66E+00	7.50E-04	6.04E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**1.5E+03**	**6.1E+04**	**2.2E+04**	**6.5E+00**	**2.1E+00**	**4.7E+00**	**7.5E-04**	**6.0E-02**

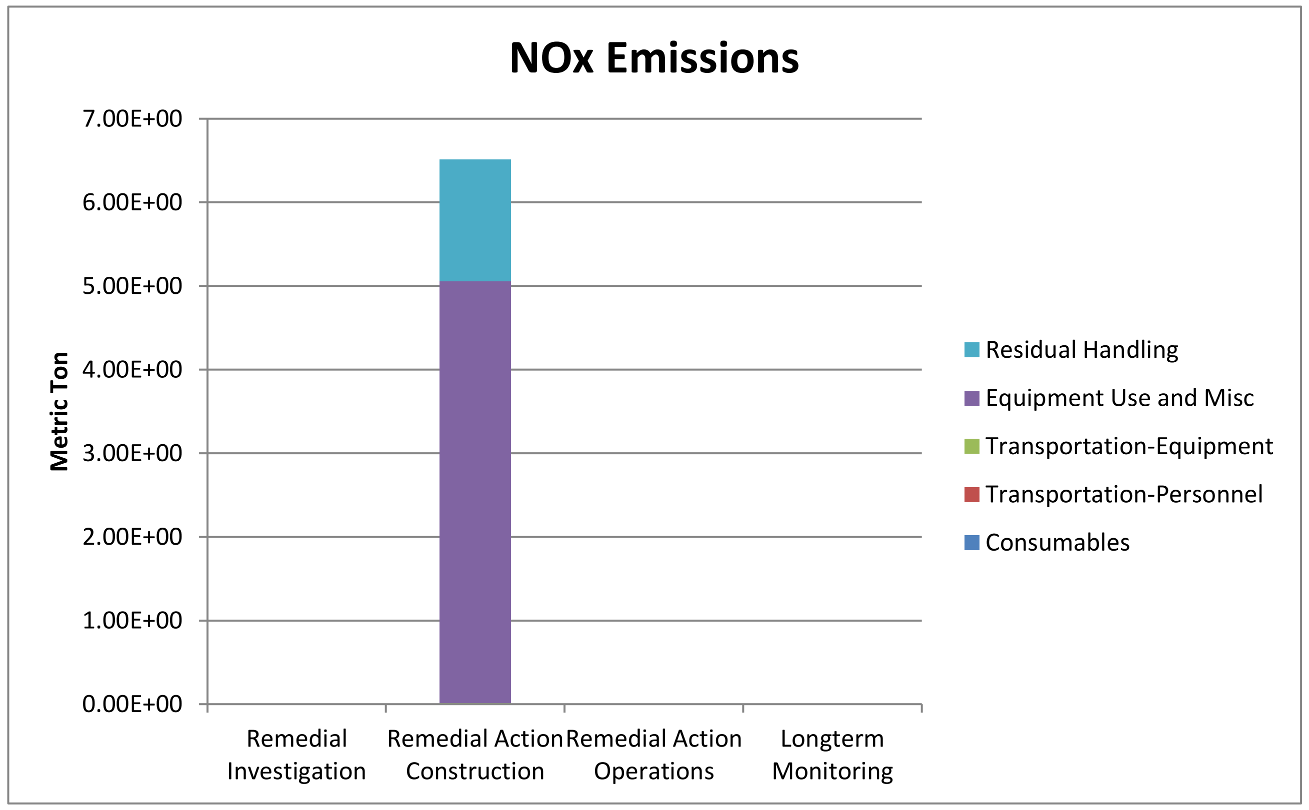
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.1E+04	1.1E+04	0.0E+00	0	4.8E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**1.1E+04**	**1.1E+04**	**0.0E+00**	**$0**	**4.8E-01**

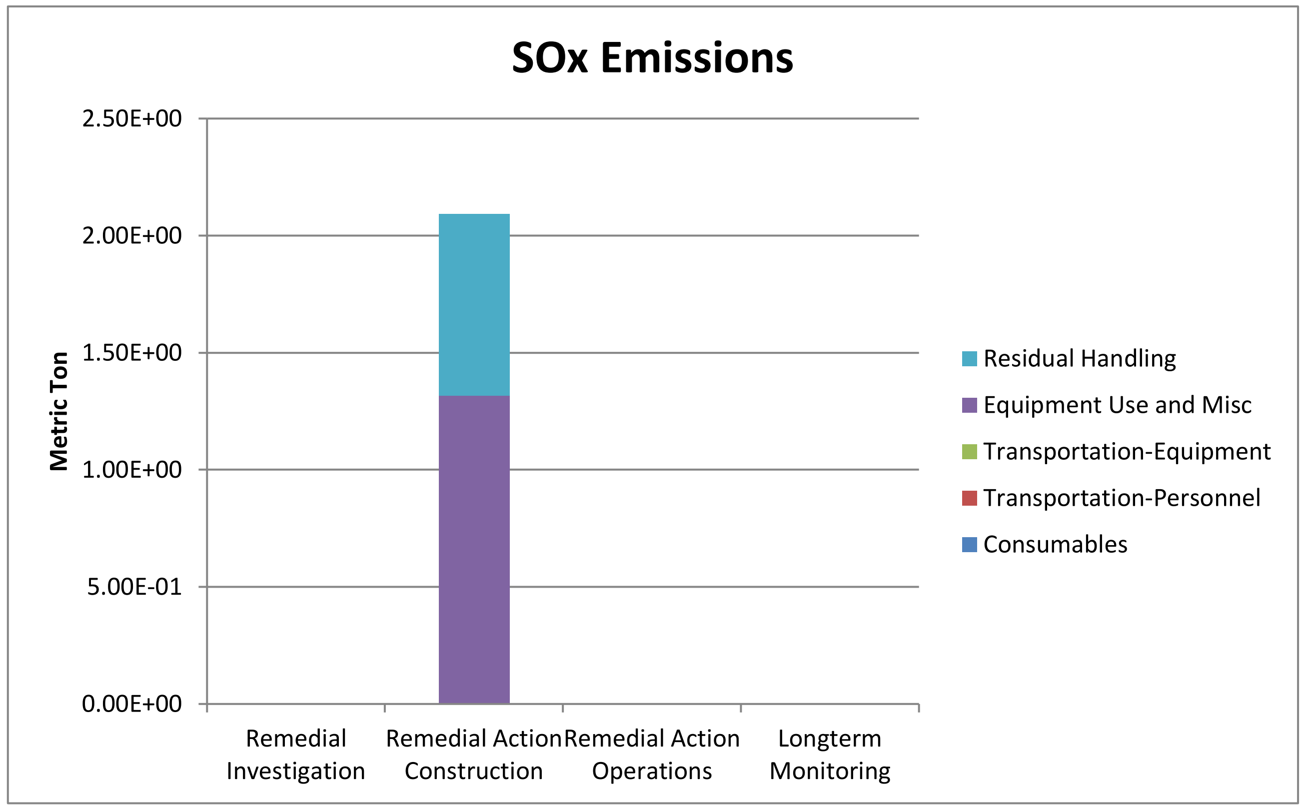
Total Cost with Footprint Reduction
$0

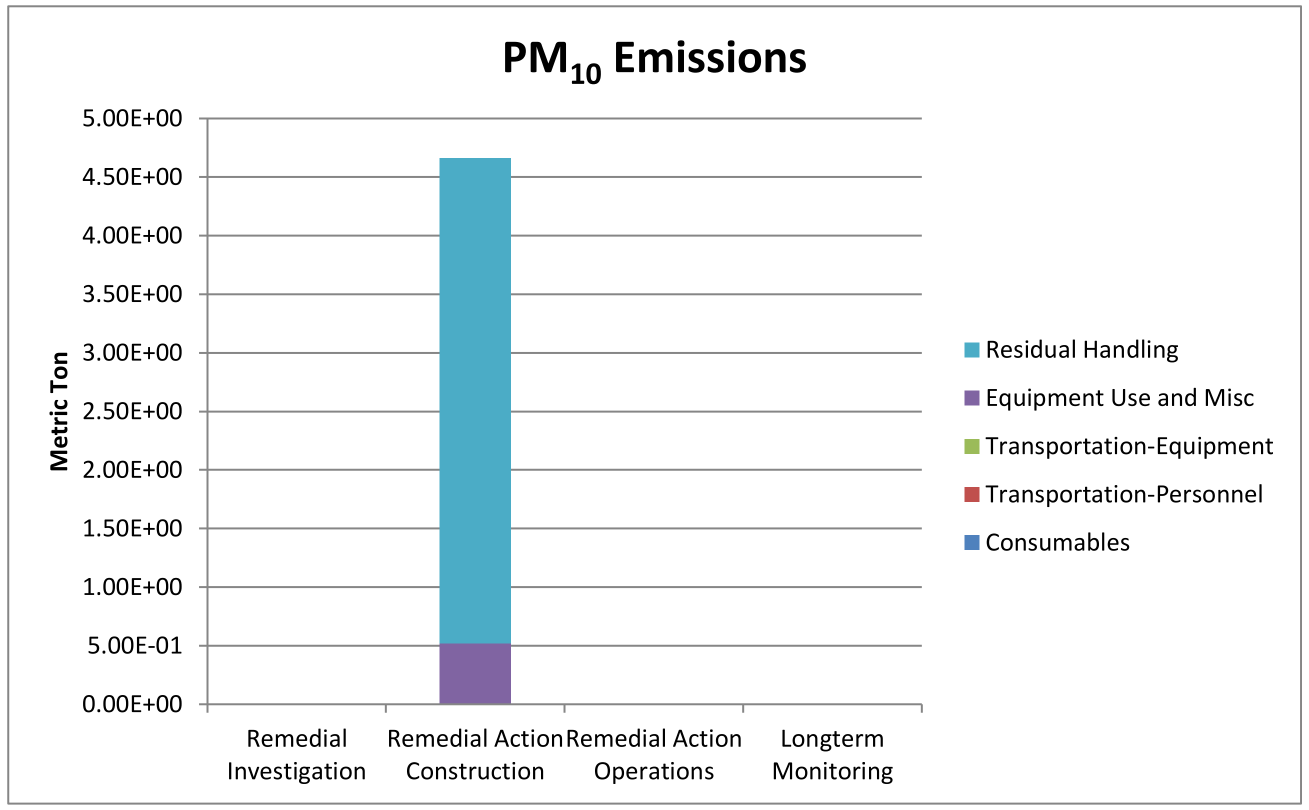

GHG Emissions
Metric Tons
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

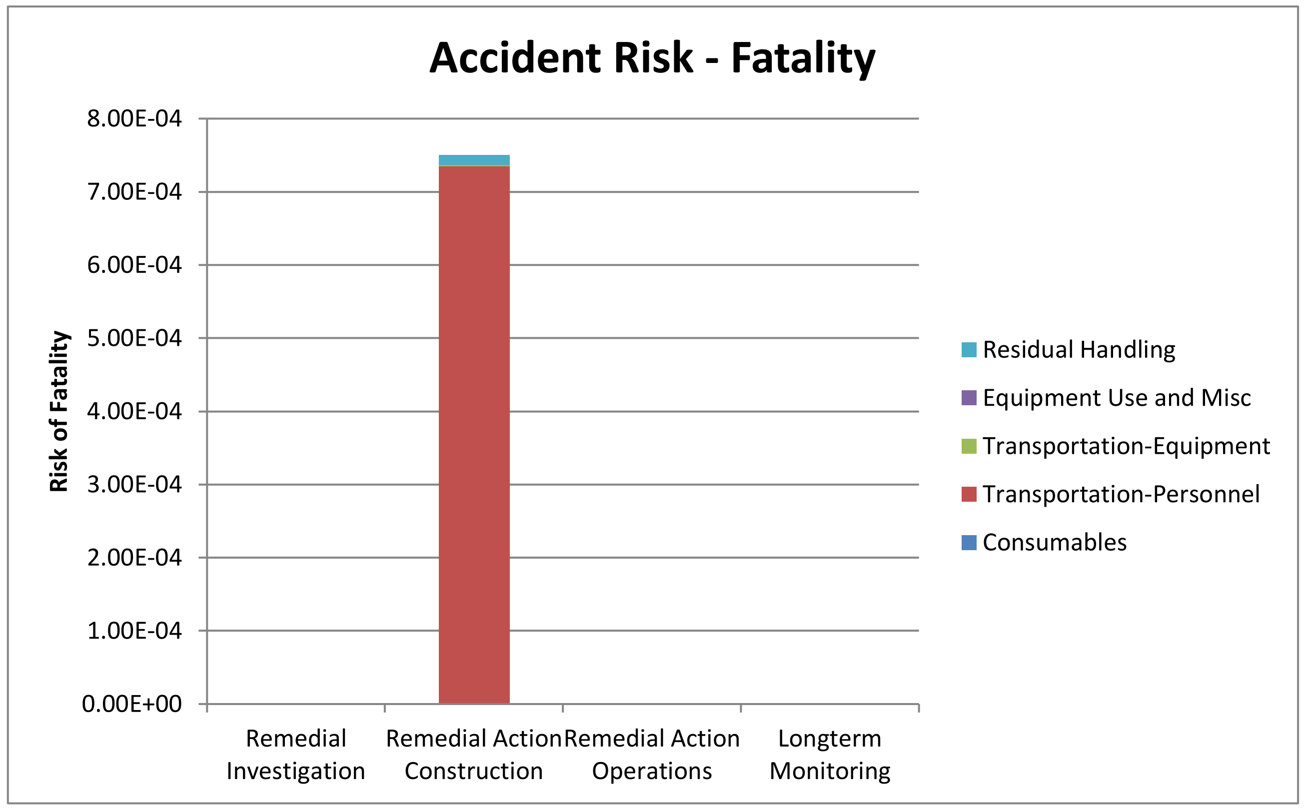

Total Energy Used
MMBTU
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

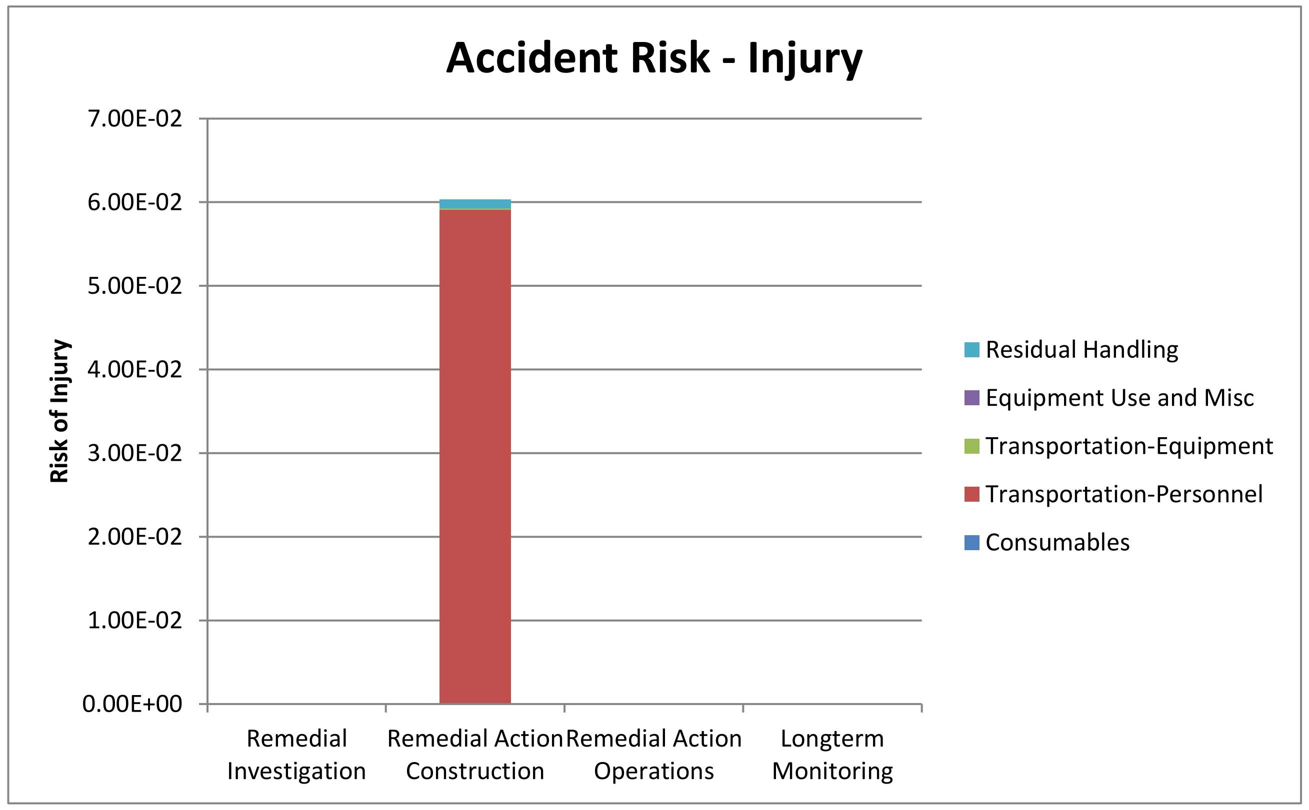

Water Consumption
Gallons
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
5.00E+00
4.50E+00
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
8.00E-04
7.00E-04
6.00E-04
5.00E-04
4.00E-04
3.00E-04
2.00E-04
1.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

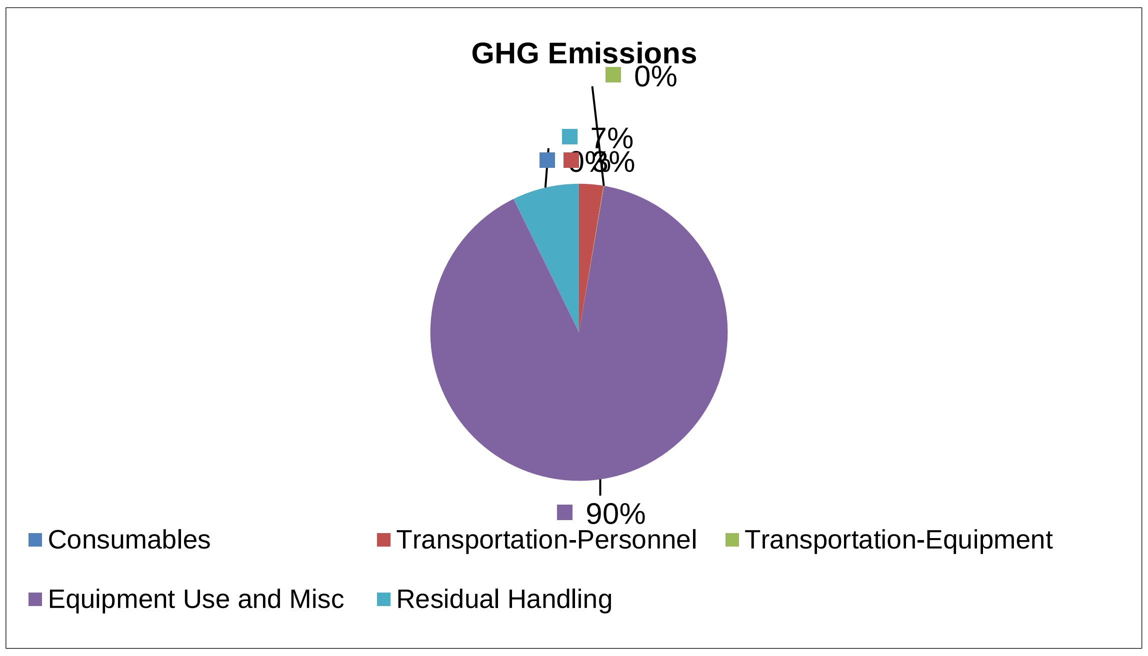

Accident Risk - Injury
Risk of Injury
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

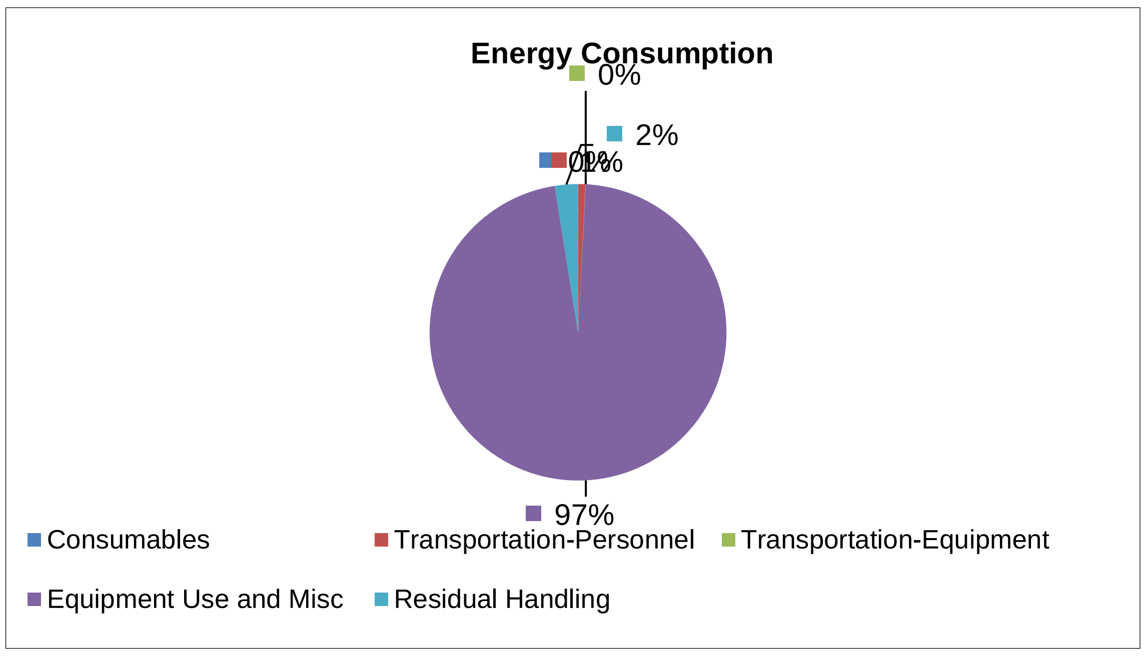
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	Materials								Tonnes				MWhr	gal x 1000
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	High Visibility - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	139.75	lbs	0.31	0.16	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	RCRA Cap, Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	10,938.00	lbs	24.41	12.90	0.03	0.09	0.00	0.05	0.01	143.14	3.93
RAC	RCRA Cap, Compacted Clay	Bentonite	compacted clay	46,000,000.00	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	RCRA Cap, Geomembrane	HDPE	geotextile, use HDPE, 0.547 lb/SF	105,000.00	lbs	234.33	123.81	0.30	0.90	0.00	0.52	0.08	1374.07	37.74
RAC	RCRA Cap Drainage	Gravel		19,502,000.00	lbs	150.36	150.36	0.00	0.00	0.00	0.00	0.00	3583.78	0.00
RAC	Clean Fill	Soil	assume top soil	36,342,000.00	lbs	379.08	379.08	0.00	0.00	0.00	0.00	0.00	10017.57	0.00
RAC	Top Soil	Soil	assume top soil	11,666,000.00	lbs	121.69	121.69	0.00	0.00	0.00	0.00	0.00	3215.70	0.00
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,020.70	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.88	1.82
	Subtotal					**945.39**	**808.98**	**0.36**	**1.12**	**0.00**	**0.65**	**0.09**	**18603.92**	**48.42**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		2,688.00	hrs	472.44	472.44	0.00	0.00	3.25	0.87	0.27	2343.32	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		5,376.00	hrs	109.09	109.09	0.00	0.00	1.00	0.20	0.13	459.90	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	2,688.00	hrs	161.18	161.18	0.00	0.00	1.07	0.29	0.11	865.06	
	Subtotal					**766.22**	**766.15**	**0.00**	**0.00**	**5.50**	**1.37**	**0.54**	**3781.89**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**1,712**	**1,575**	**0.36**	**1.12**	**5.50**	**2.02**	**0.63**	**22,386**	**48**

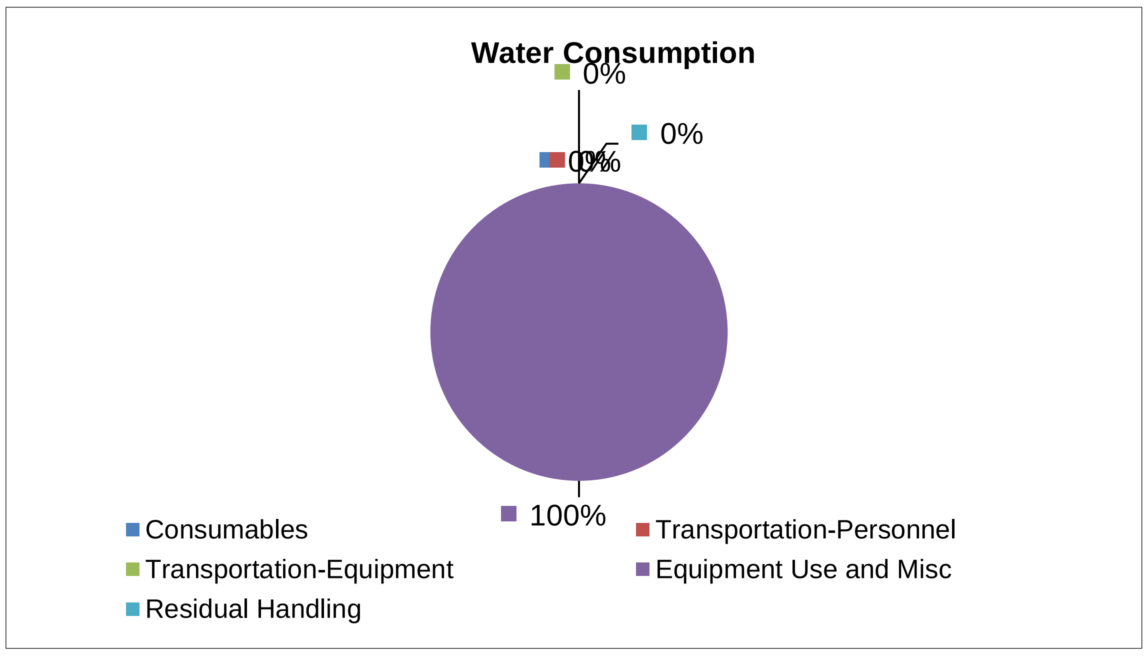
Alternative 1
Values Input into SiteWise as "Other"

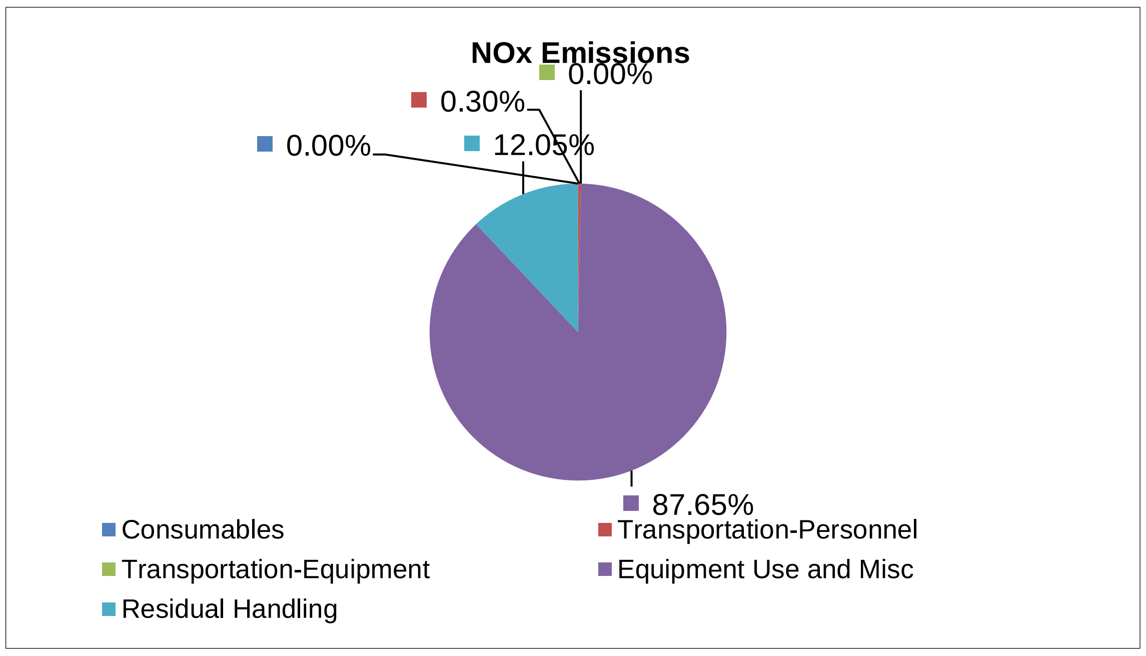
Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	1,711.61	1,575.13	112.96	23.52	5.50	2.02	0.63	76,380.41	48,420.72
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

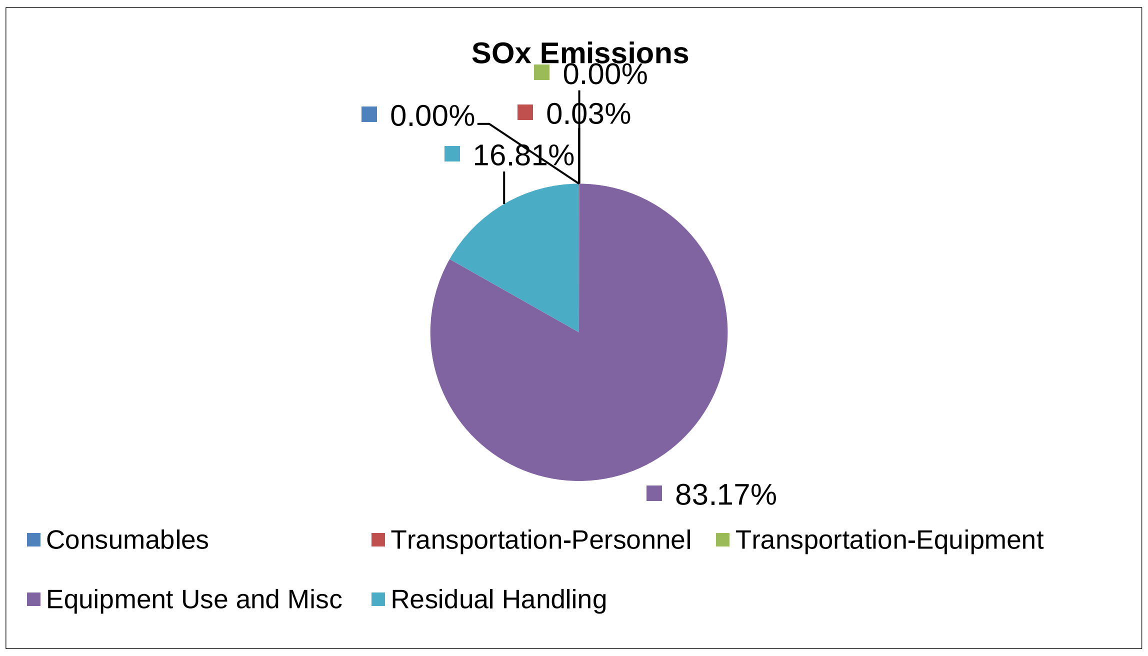
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

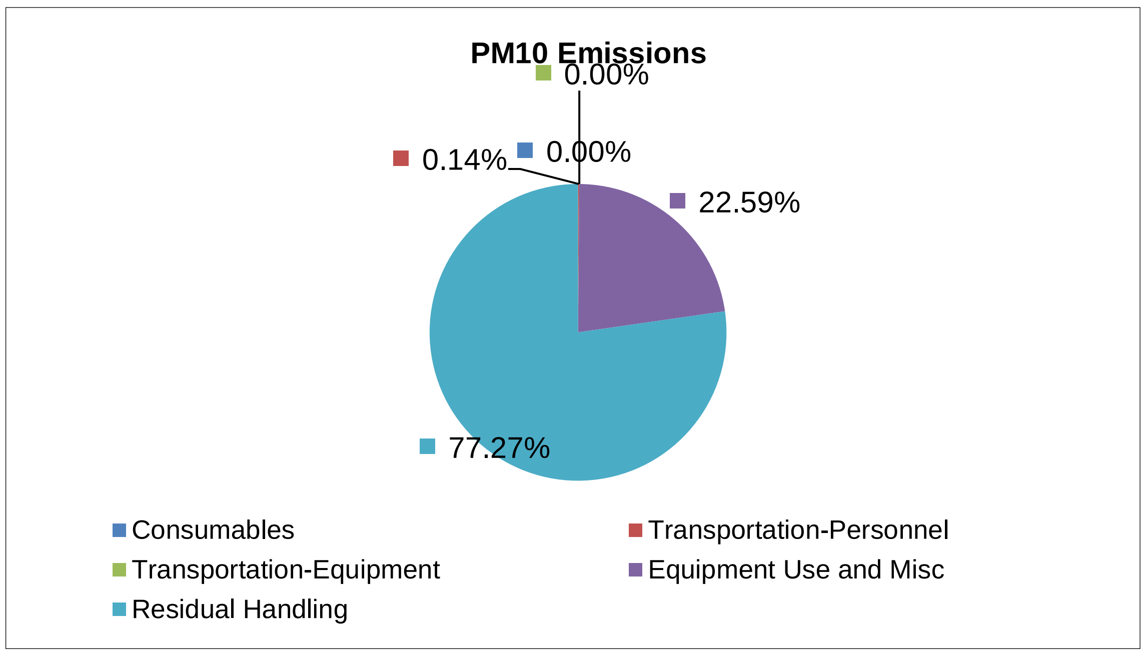

GHG Emissions
0%
7%
0%
3%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

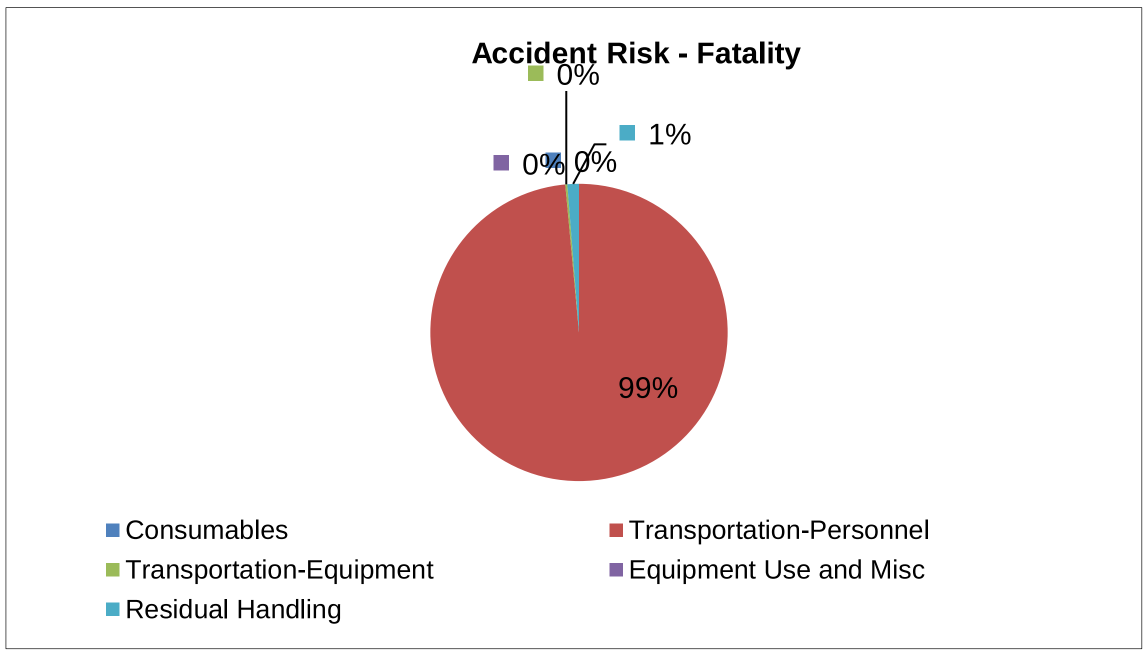

Energy Consumption
0%
2%
0%
0%
97%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

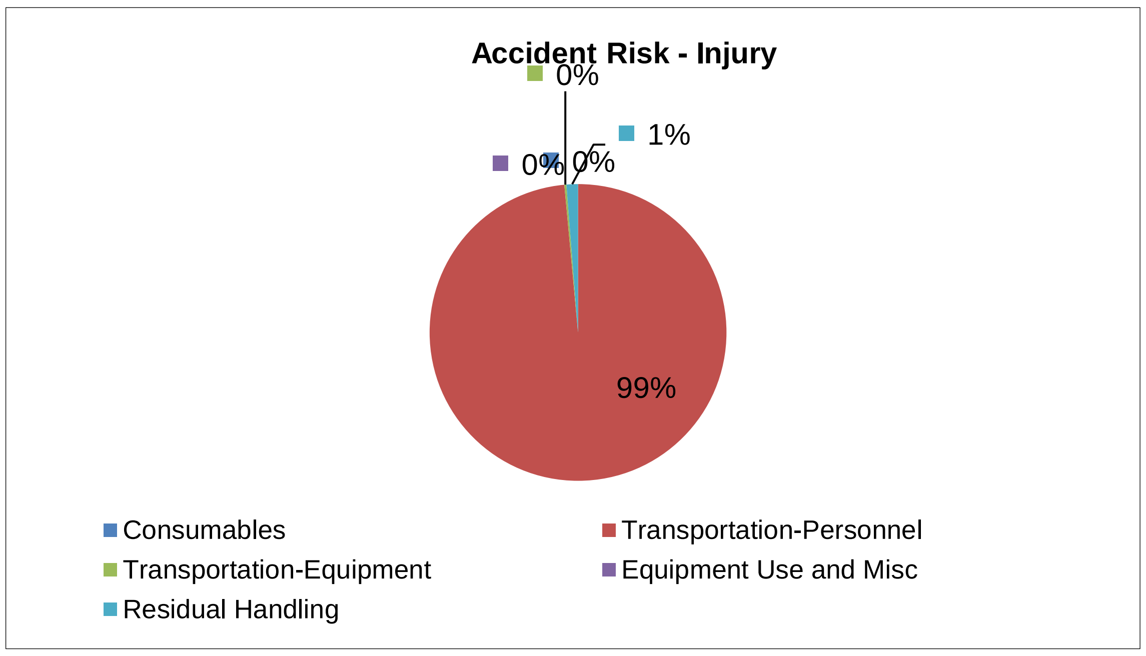

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.30%
0.00%
12.05%
87.65%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
0.00%
0.03%
16.81%
83.17%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
0.14%
0.00%
22.59%
77.27%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

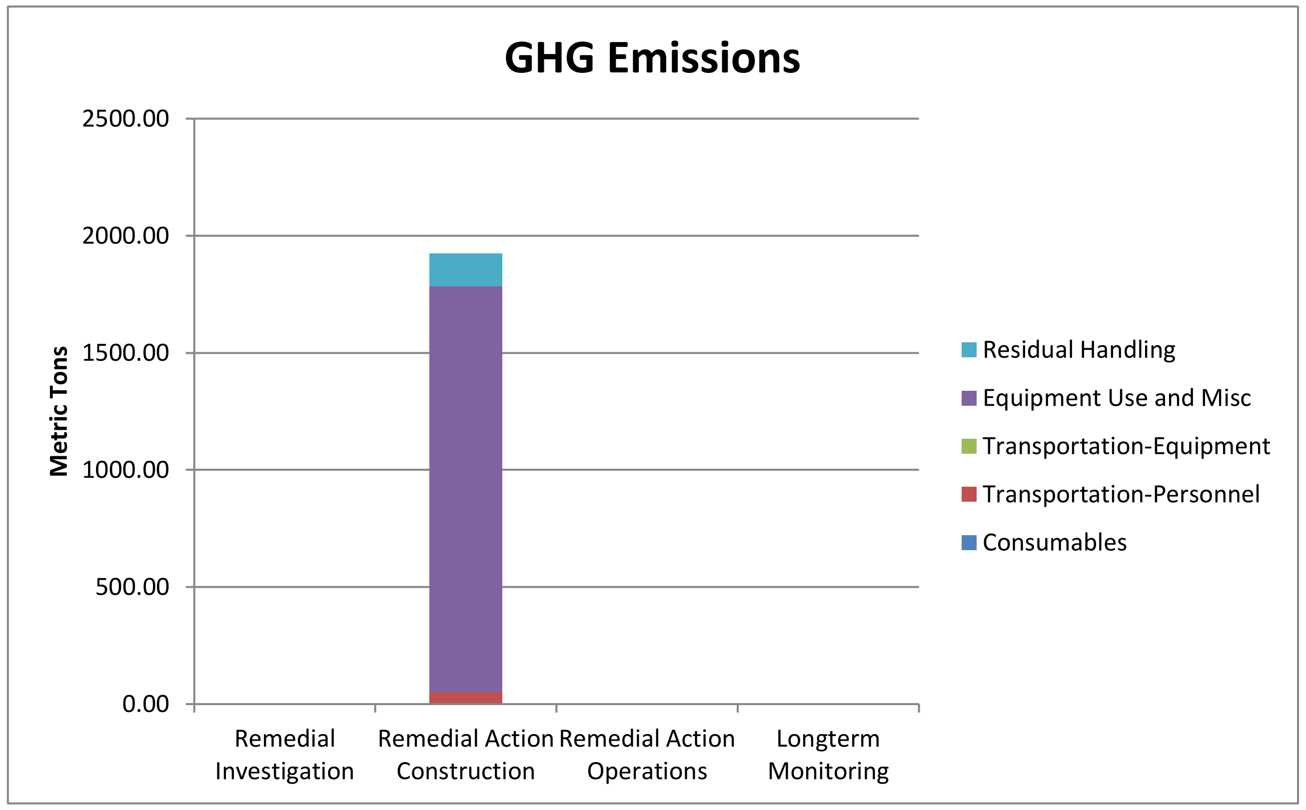

Accident Risk - Injury
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

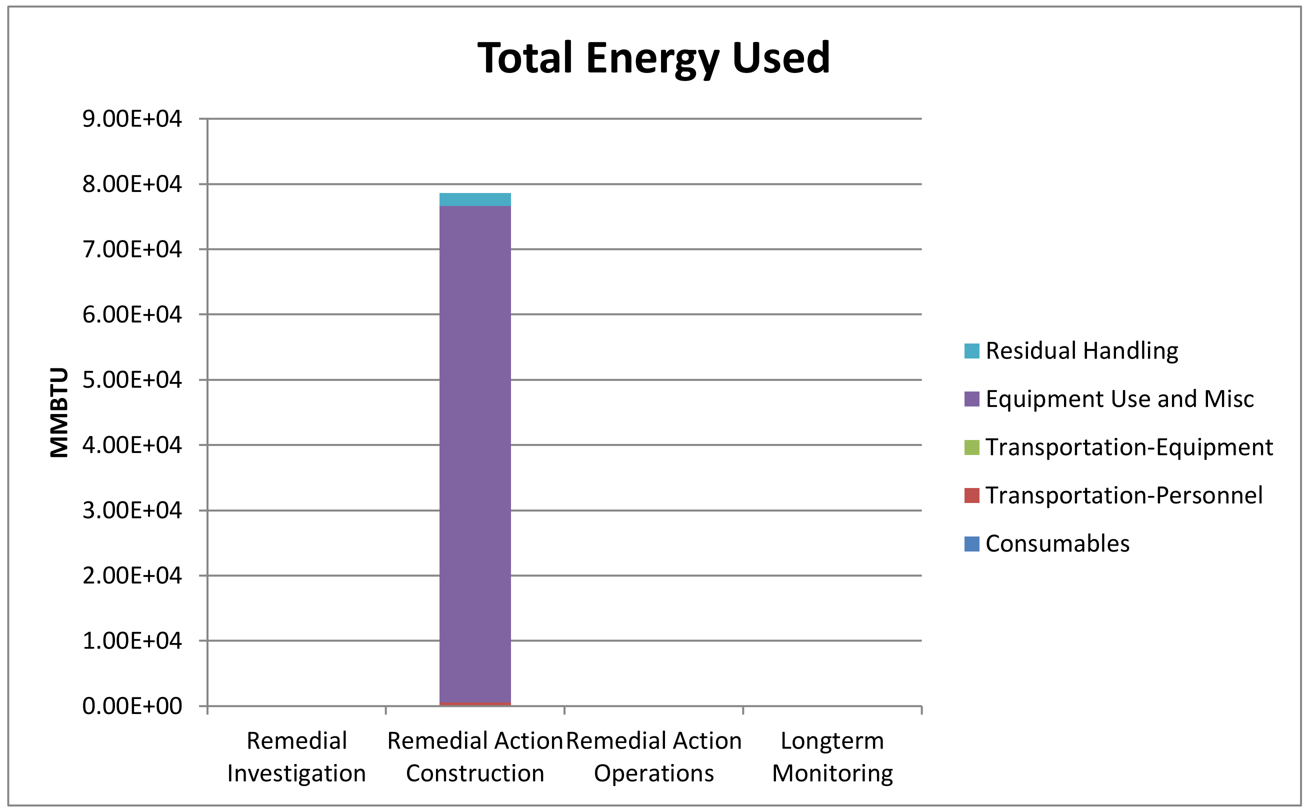
Sustainable Remediation - Environmental Footprint Summary

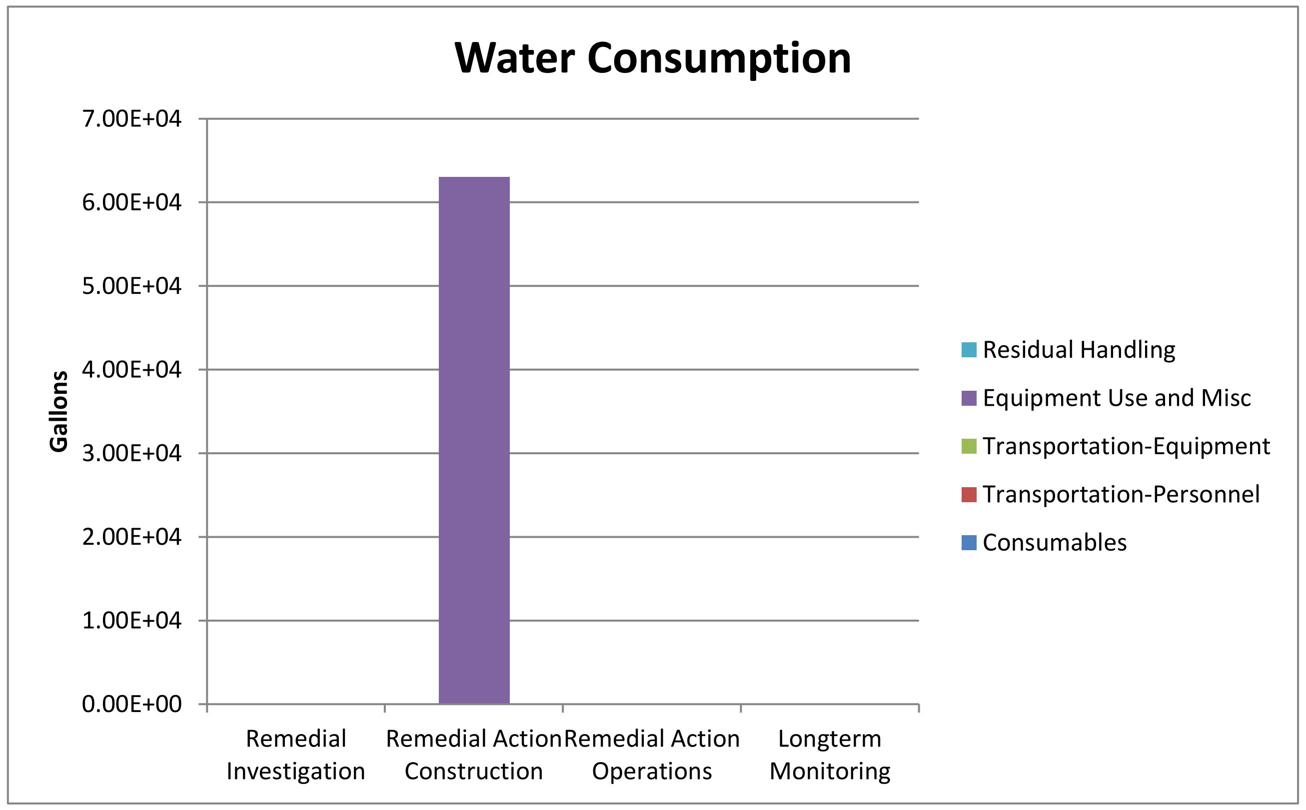
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	50.93	6.4E+02	NA	1.9E-02	6.6E-04	3.8E-03	1.0E-03	8.4E-02
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	1,734.03	7.6E+04	6.3E+04	5.5E+00	2.0E+00	6.3E-01	0.0E+00	0.0E+00
	Residual Handling	139.74	2.0E+03	NA	7.6E-01	4.0E-01	2.2E+00	1.3E-05	1.1E-03
	Sub-Total	1,925.63	7.86E+04	6.30E+04	6.28E+00	2.40E+00	2.79E+00	1.06E-03	8.52E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**1.9E+03**	**7.9E+04**	**6.3E+04**	**6.3E+00**	**2.4E+00**	**2.8E+00**	**1.1E-03**	**8.5E-02**

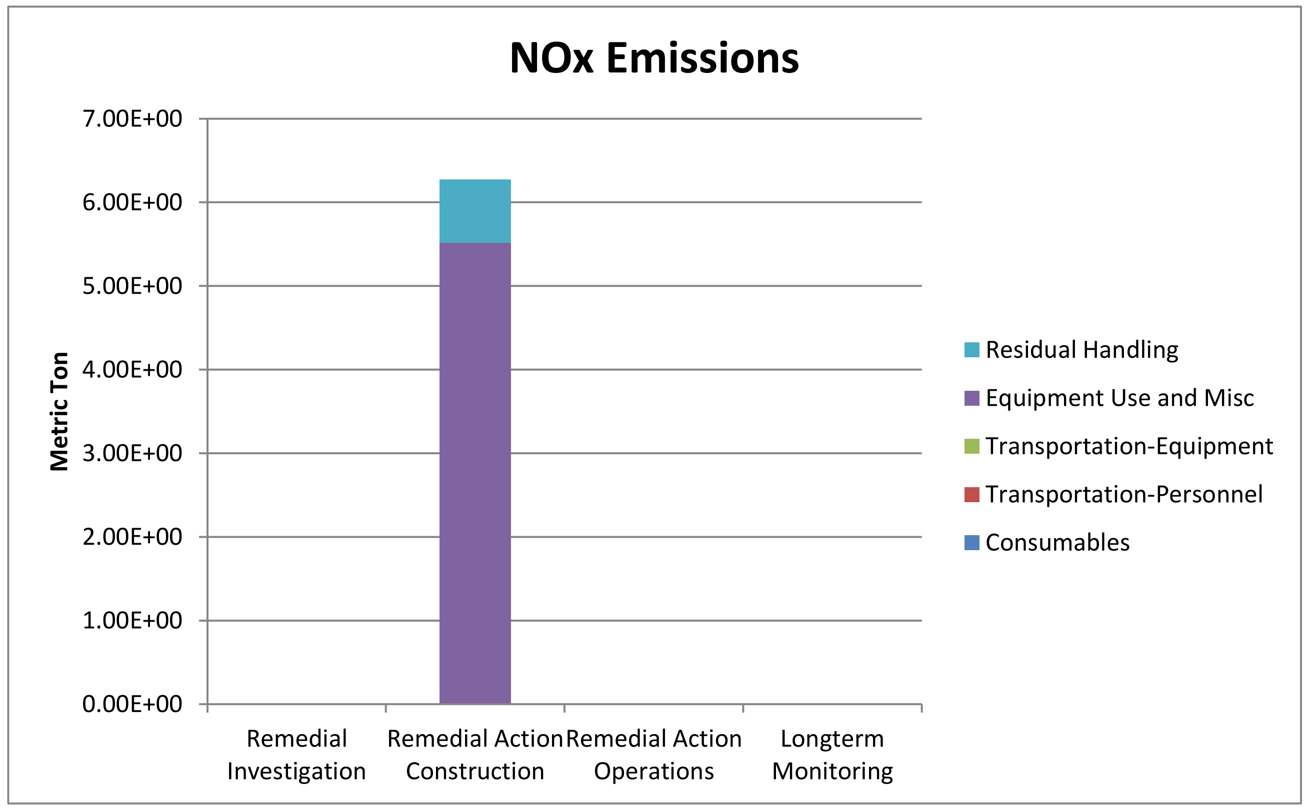
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	5.9E+03	5.4E+03	0.0E+00	0	6.8E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**5.9E+03**	**5.4E+03**	**0.0E+00**	**$0**	**6.8E-01**

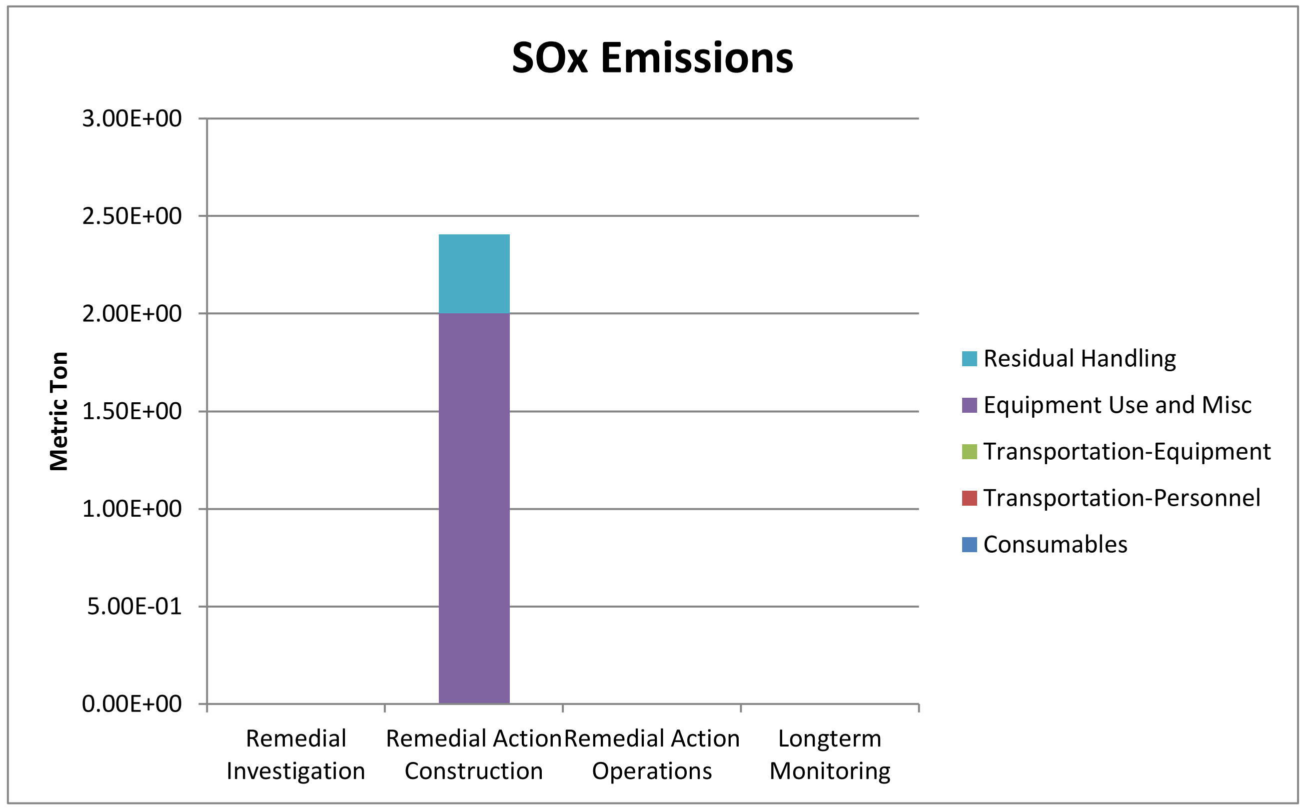
Total Cost with Footprint Reduction
$0

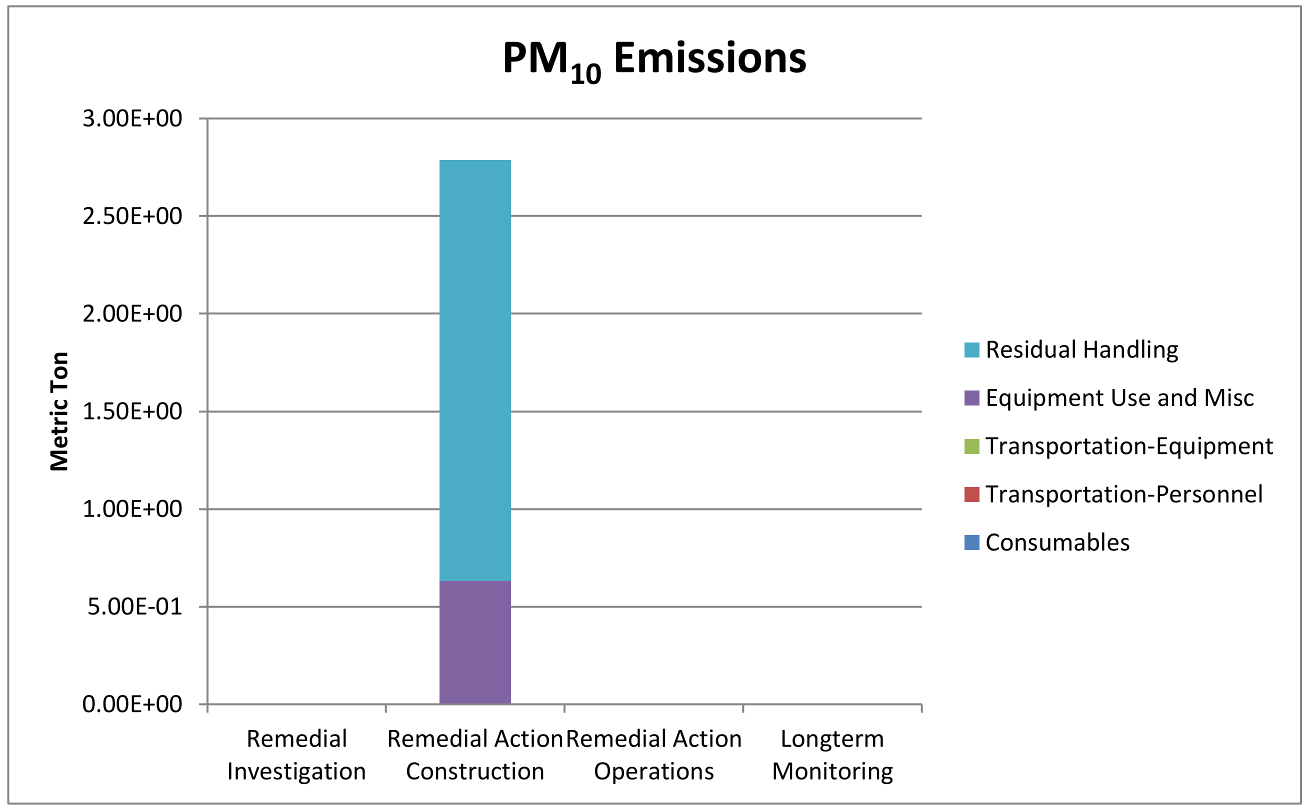

GHG Emissions
Metric Tons
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

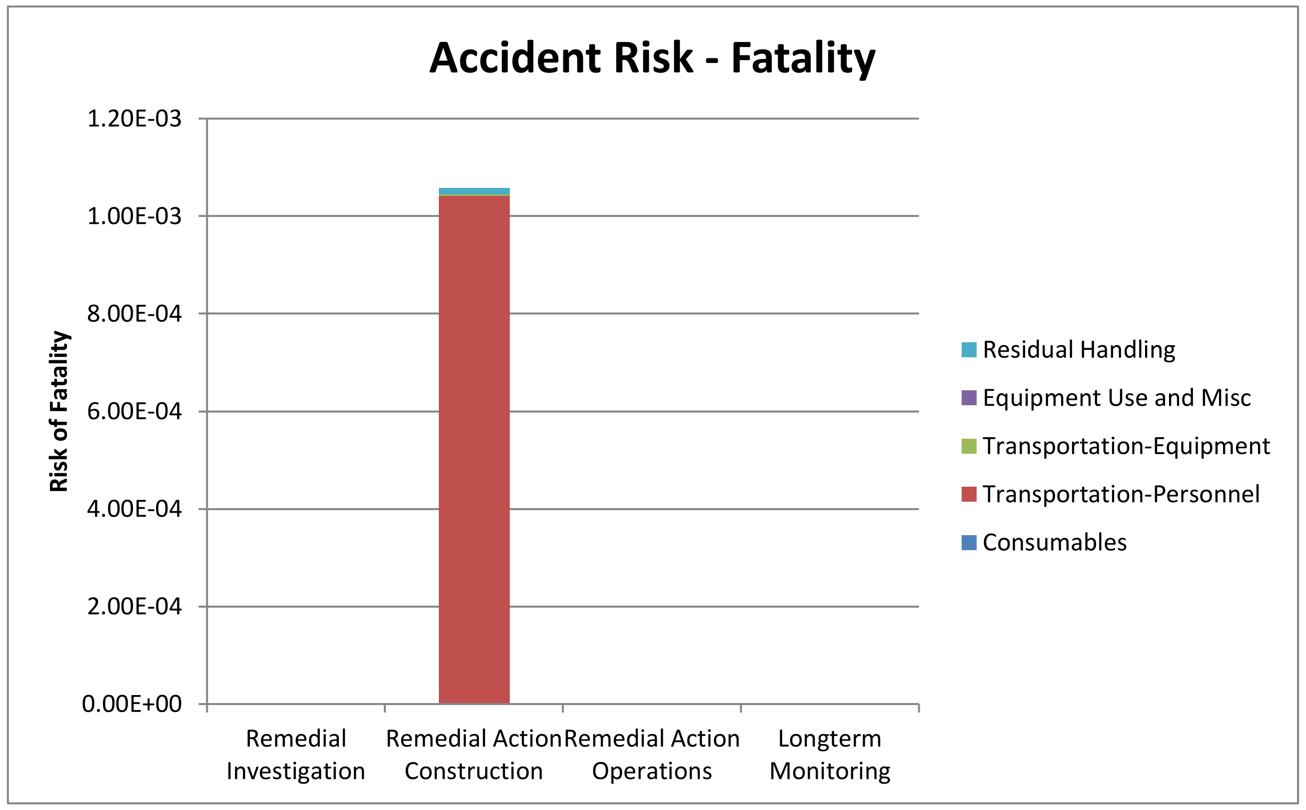

Total Energy Used
MMBTU
9.00E+04
8.00E+04
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

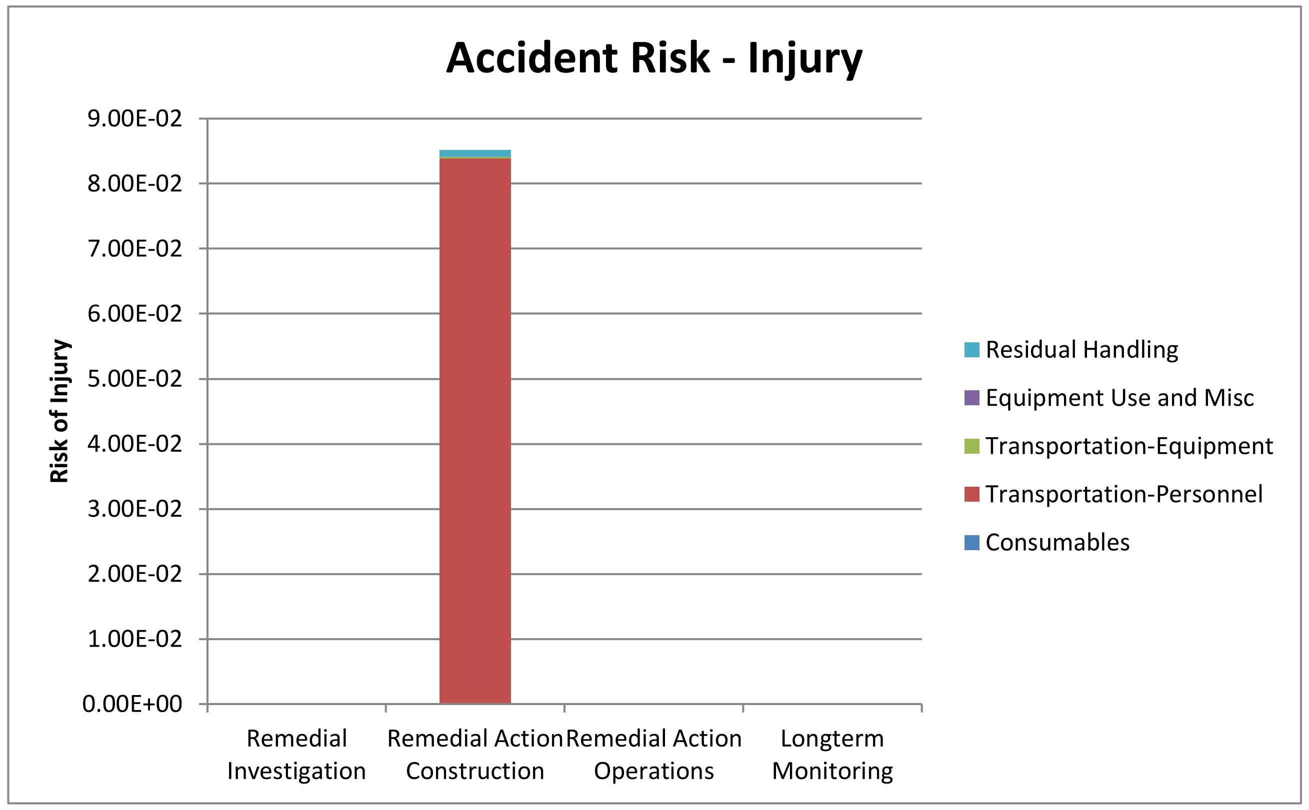

Water Consumption
Gallons
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

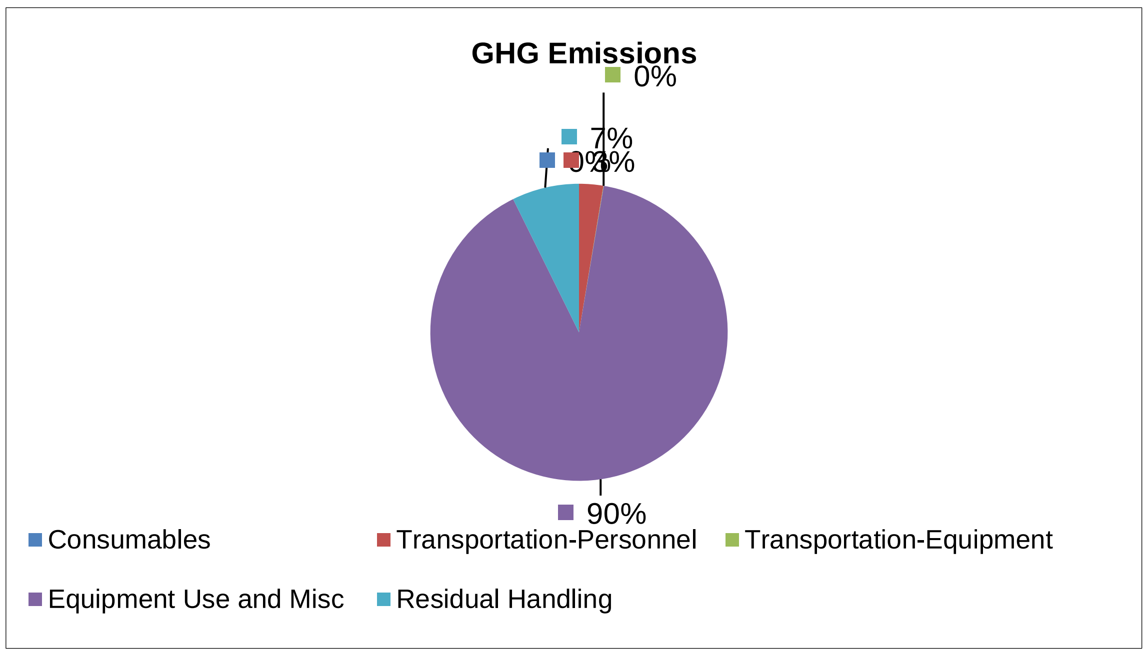

Accident Risk - Injury
Risk of Injury
9.00E-02
8.00E-02
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

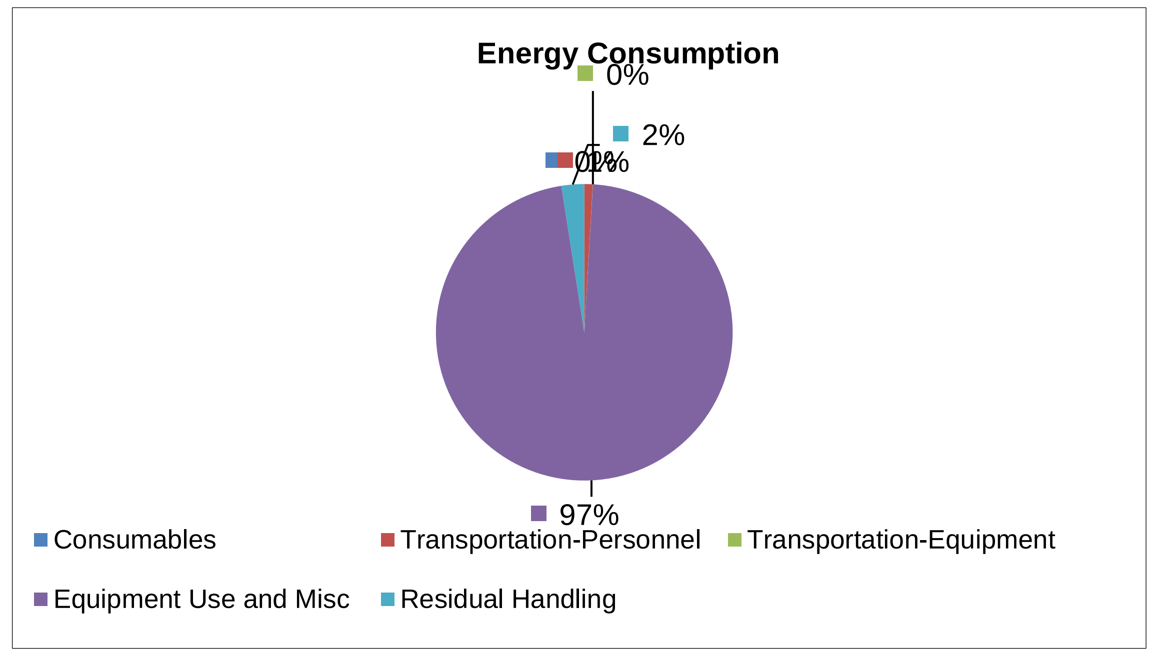
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	Materials								Tonnes				MWhr	gal x 1000
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	High Visibility - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	139.75	lbs	0.31	0.16	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	RCRA Cap, Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	10,938.00	lbs	24.41	12.90	0.03	0.09	0.00	0.05	0.01	143.14	3.93
RAC	RCRA Cap, Compacted Clay	Bentonite	compacted clay	46,000,000.00	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	RCRA Cap, Drainage Layer	Gravel		19,502,000.00	lbs	150.36	150.36	0.00	0.00	0.00	0.00	0.00	3583.78	0.00
RAC	RCRA Cap, Geotextile	HDPE	geotextile, use HDPE, 80-mil	105,000.00	lbs	234.33	123.81	0.30	0.90	0.00	0.52	0.08	1374.07	37.74
RAC	Solidification - Portland Cement	Typical Cement		1,223,600.00	lbs	460.58	460.58	0.00	0.00	0.00	0.00	0.00	3447.77	0.00
RAC	Clean Fill	Soil	assume top soil	36,342,000.00	lbs	379.08	379.08	0.00	0.00	0.00	0.00	0.00	10017.57	0.00
RAC	Top Soil	Soil	assume top soil	11,666,000.00	lbs	121.69	121.69	0.00	0.00	0.00	0.00	0.00	3215.70	0.00
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,020.70	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.88	1.82
	Subtotal					**1405.98**	**1269.56**	**0.36**	**1.12**	**0.00**	**0.65**	**0.09**	**22051.69**	**48.42**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Install Vertical Barrier	Drill Rig, HSA (diesel)	80% utilization	3,456.00	hrs	191.75	188.24	0.00	0.17	2.20	0.04	0.14	879.92	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		2,688.00	hrs	472.44	472.44	0.00	0.00	3.25	0.87	0.27	2343.32	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		5,376.00	hrs	109.09	109.09	0.00	0.00	1.00	0.20	0.13	459.90	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	2,688.00	hrs	161.18	161.18	0.00	0.00	1.07	0.29	0.11	865.06	
	Subtotal					**957.97**	**954.38**	**0.00**	**0.17**	**7.71**	**1.41**	**0.67**	**4661.81**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**2,364**	**2,224**	**0.36**	**1.29**	**7.71**	**2.06**	**0.77**	**26,714**	**48**

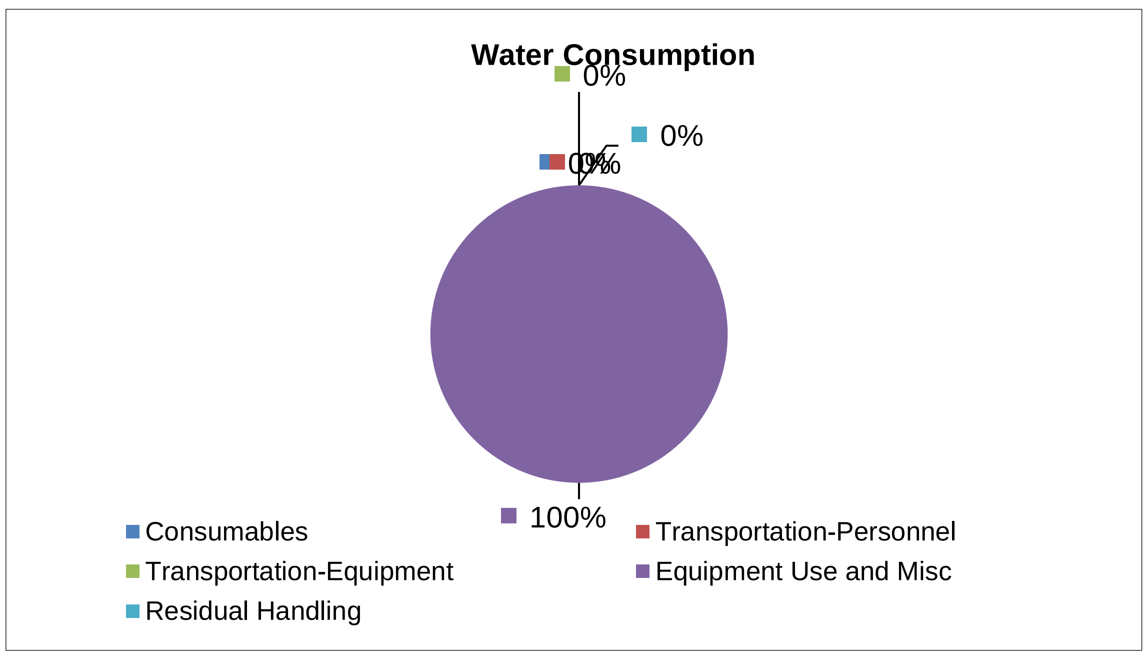
Alternative 1
Values Input into SiteWise as "Other"

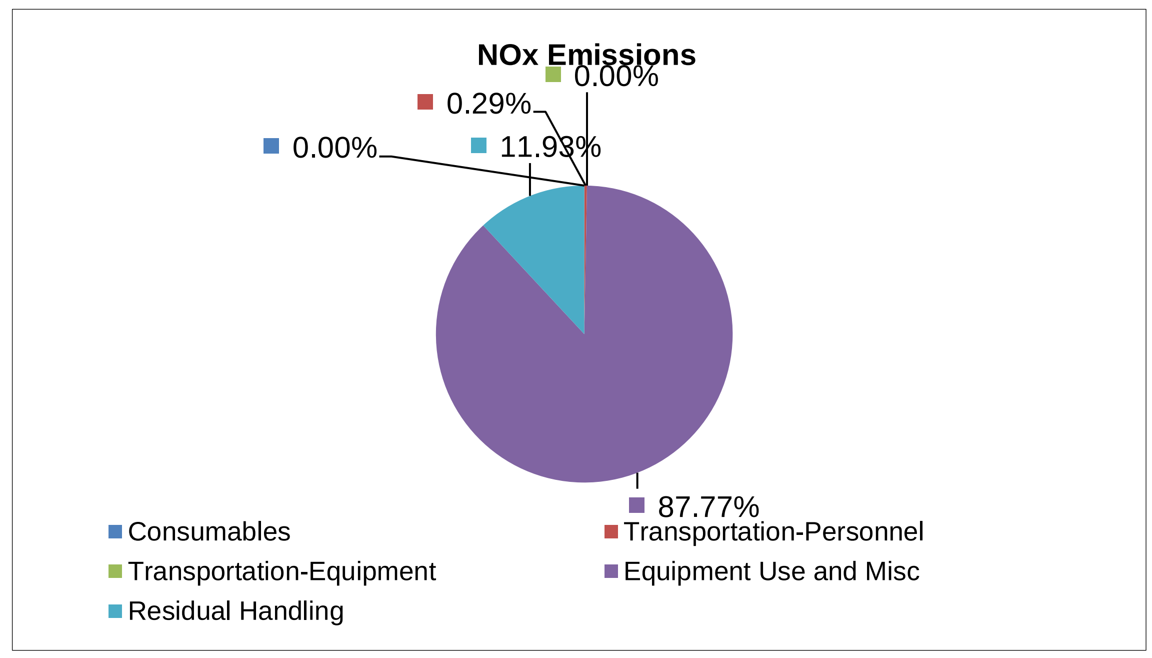
Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	2,363.95	2,223.95	112.96	27.04	7.71	2.06	0.77	91,146.47	48,420.72
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

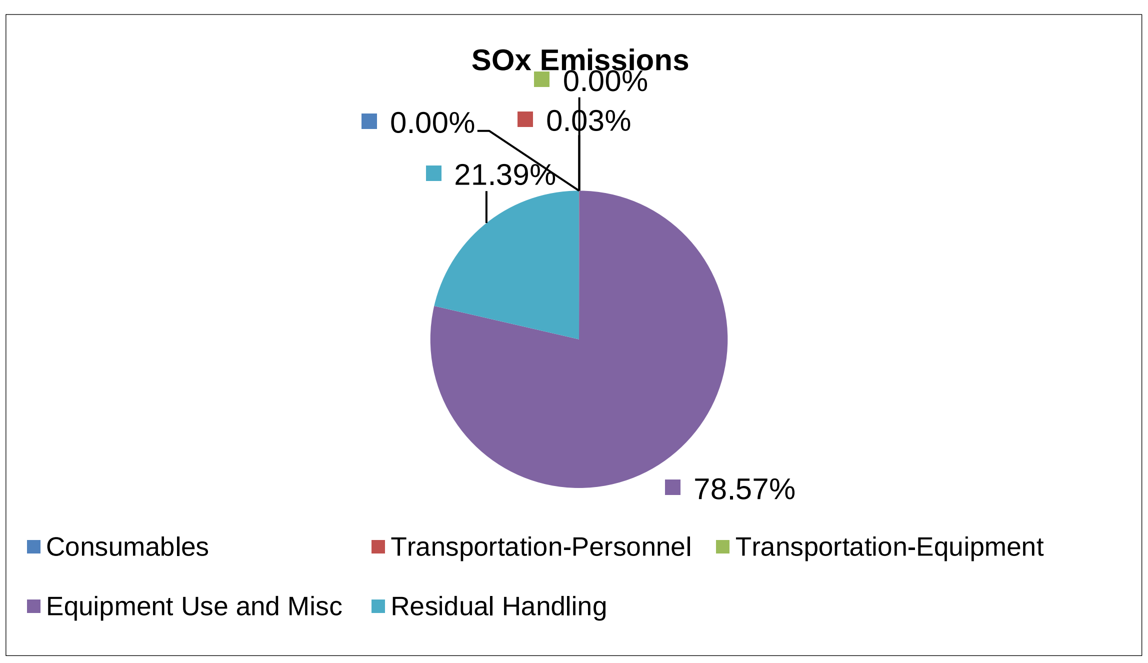
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

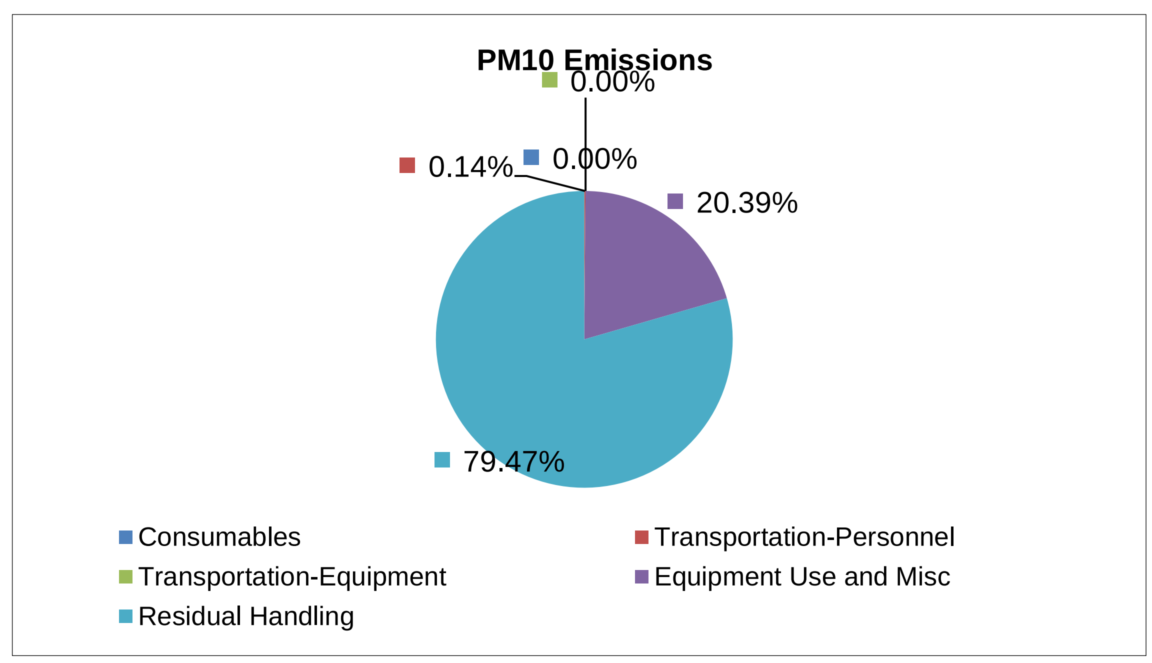

GHG Emissions
0%
7%
0%
3%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

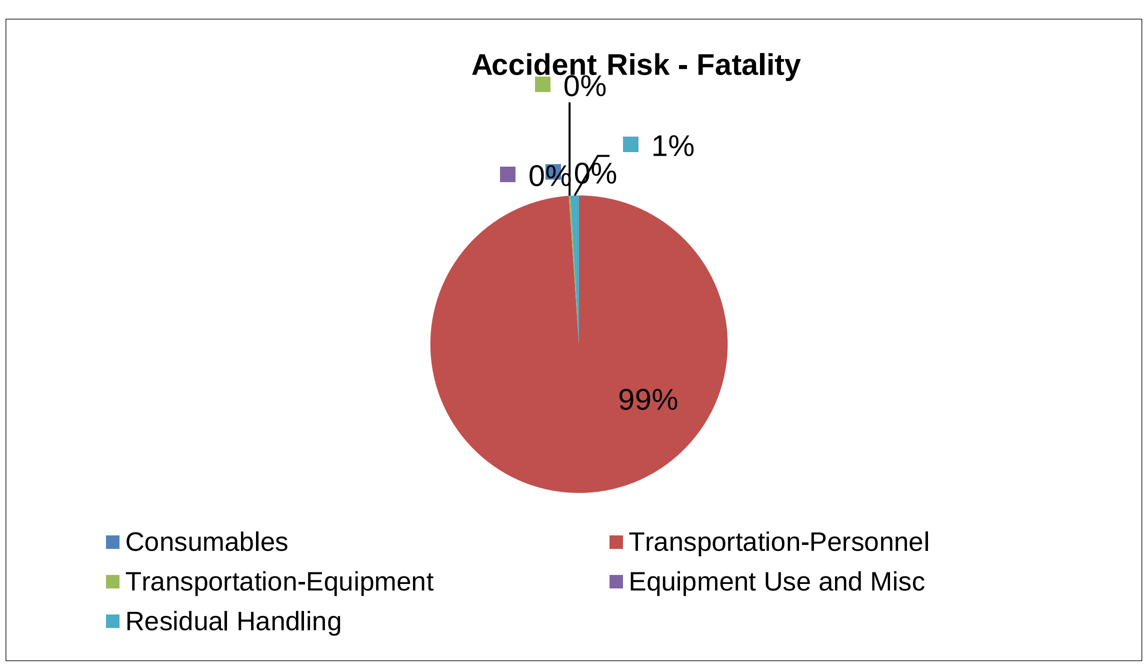

Energy Consumption
0%
2%
0%
1%
97%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

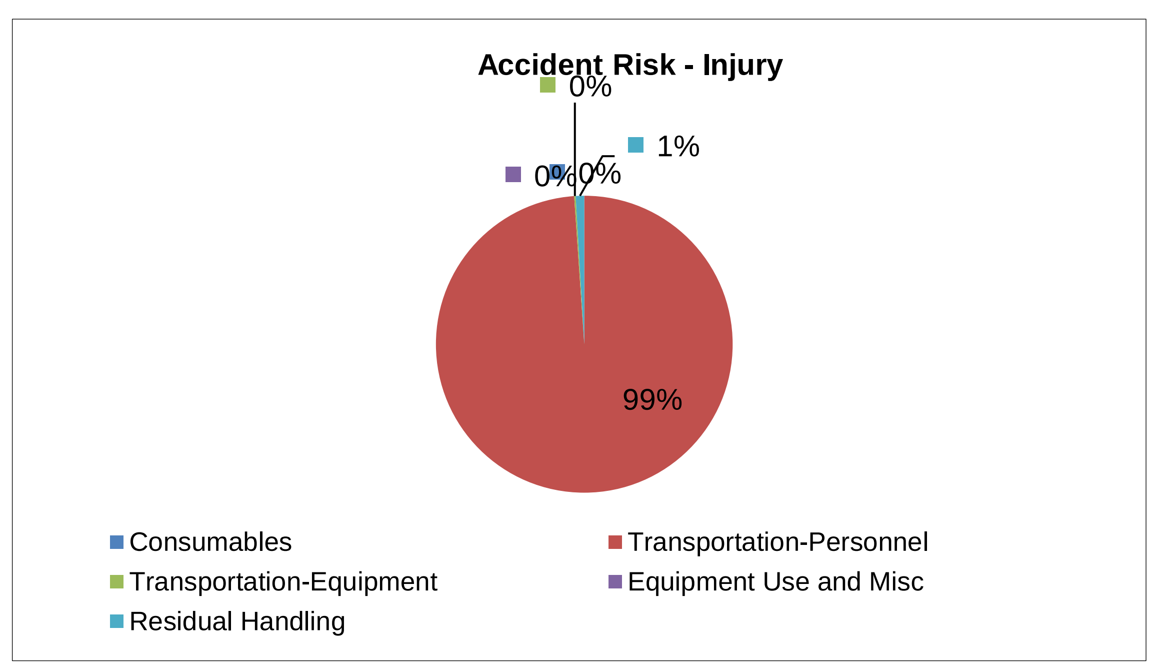

Water Consumption
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.29%
0.00%
11.93%
87.77%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
0.00%
0.03%
21.39%
78.57%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
0.14%
0.00%
20.39%
79.47%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

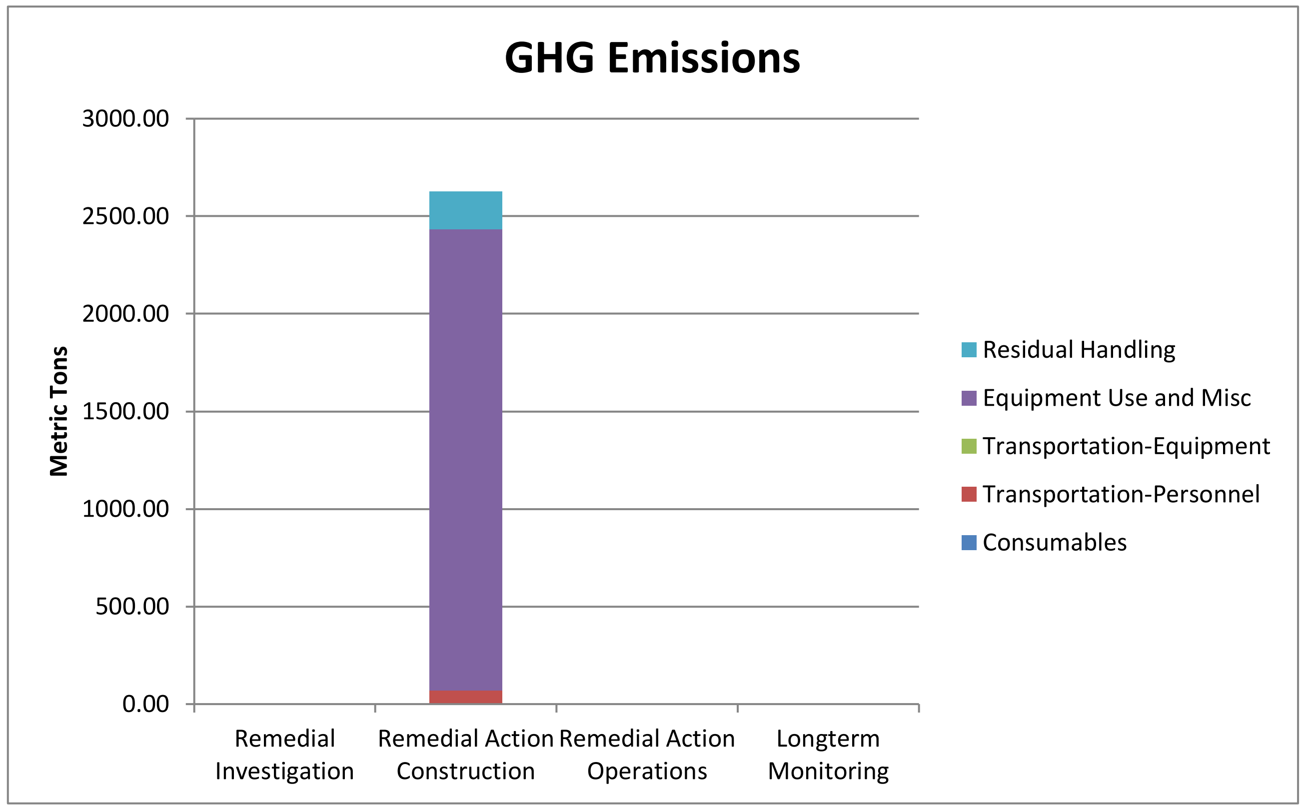

Accident Risk - Injury
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

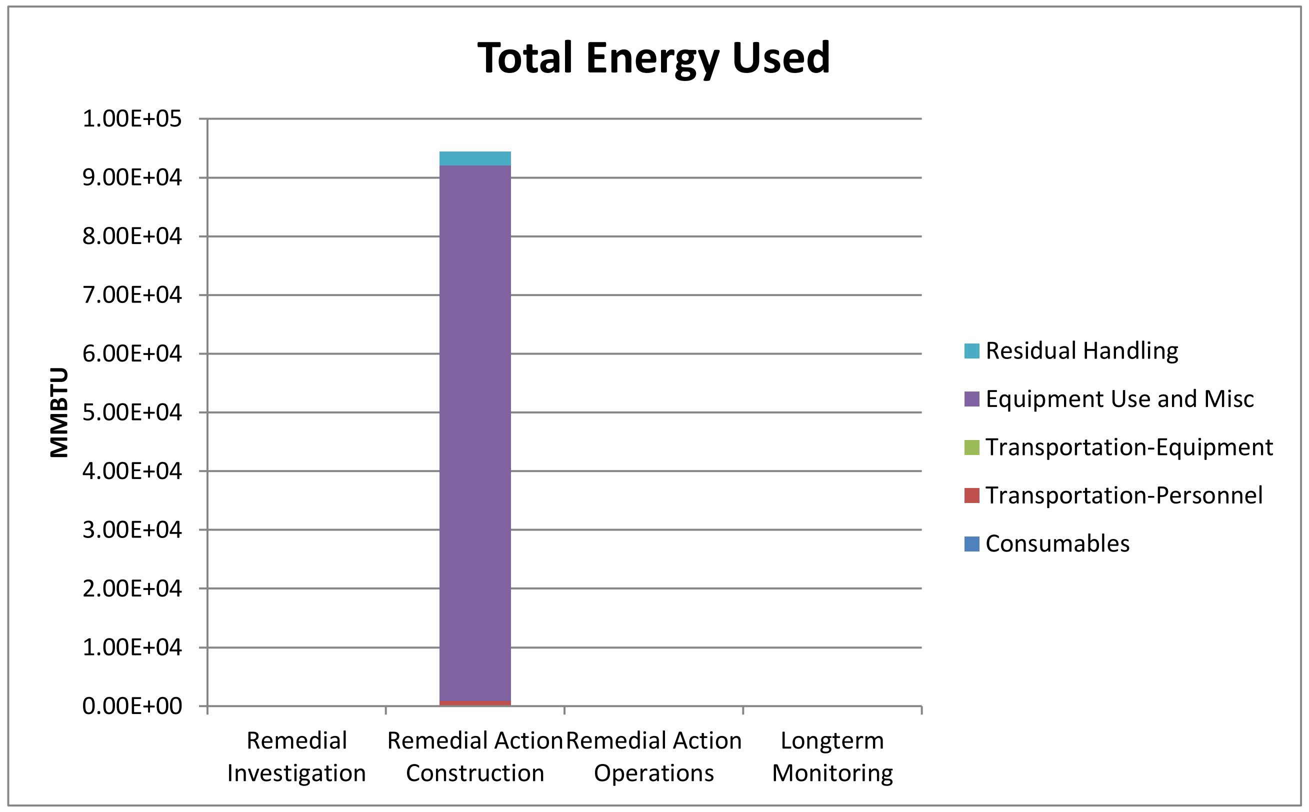
Sustainable Remediation - Environmental Footprint Summary

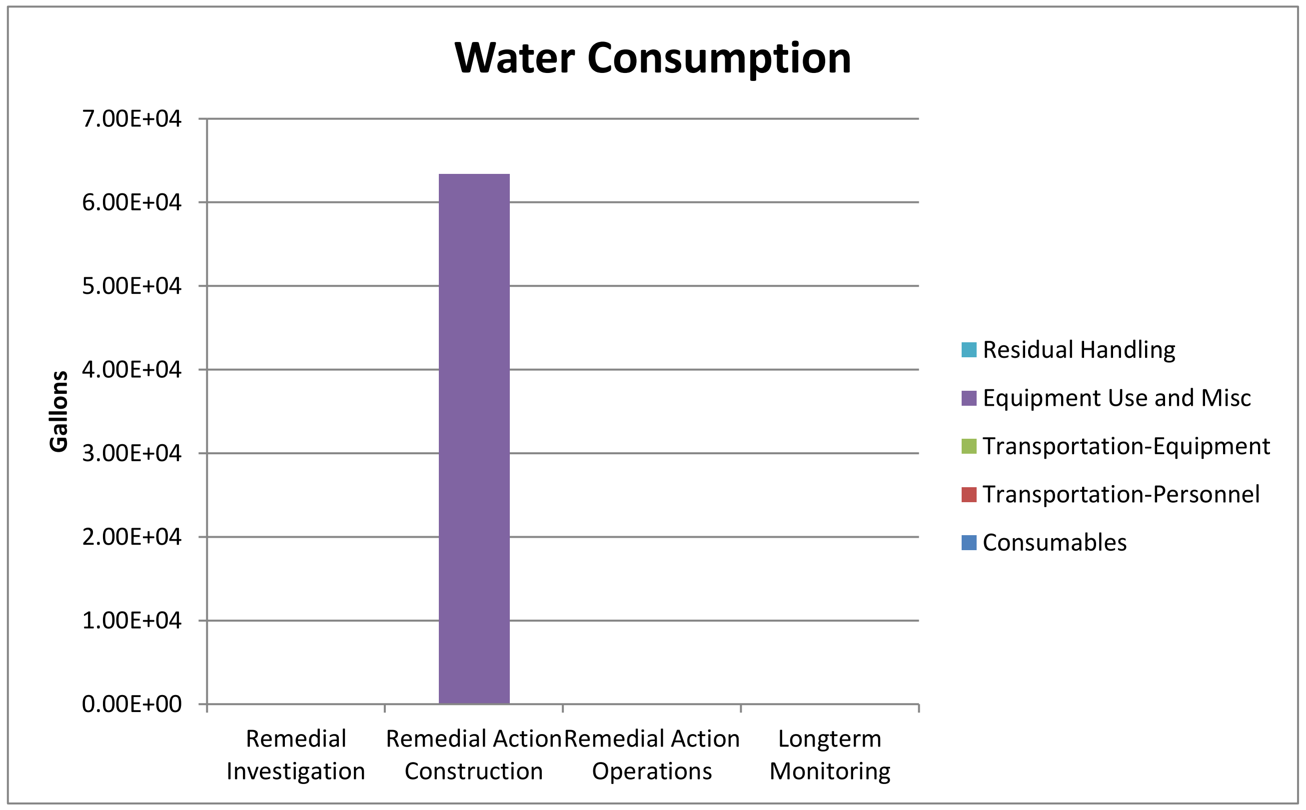
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	69.04	8.7E+02	NA	2.6E-02	9.0E-04	5.2E-03	1.4E-03	1.1E-01
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	2,363.98	9.1E+04	6.3E+04	7.7E+00	2.1E+00	7.7E-01	0.0E+00	0.0E+00
	Residual Handling	191.91	2.3E+03	NA	1.0E+00	5.6E-01	3.0E+00	1.3E-05	1.1E-03
	Sub-Total	2,625.85	9.44E+04	6.34E+04	8.78E+00	2.62E+00	3.76E+00	1.43E-03	1.15E-01
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**2.6E+03**	**9.4E+04**	**6.3E+04**	**8.8E+00**	**2.6E+00**	**3.8E+00**	**1.4E-03**	**1.1E-01**

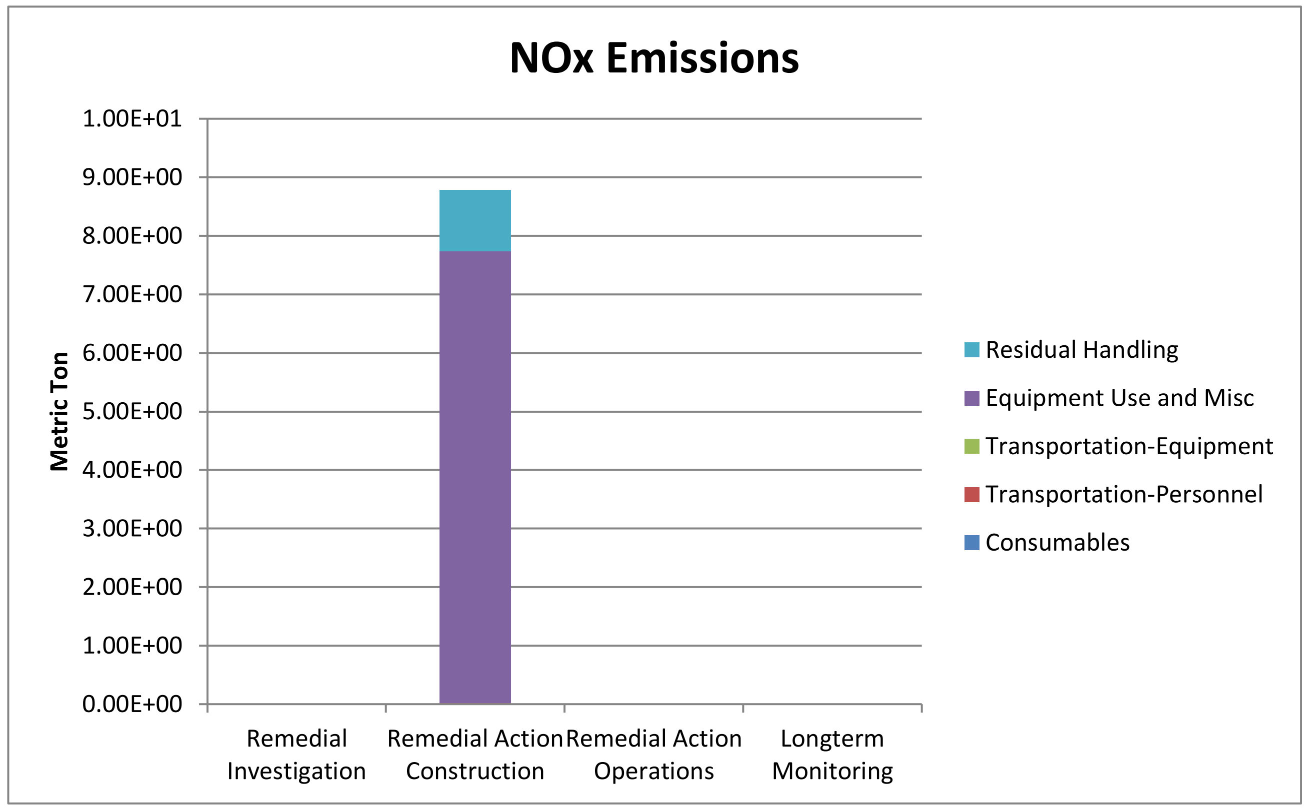
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.1E+04	5.4E+03	0.0E+00	0	9.2E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**1.1E+04**	**5.4E+03**	**0.0E+00**	**$0**	**9.2E-01**

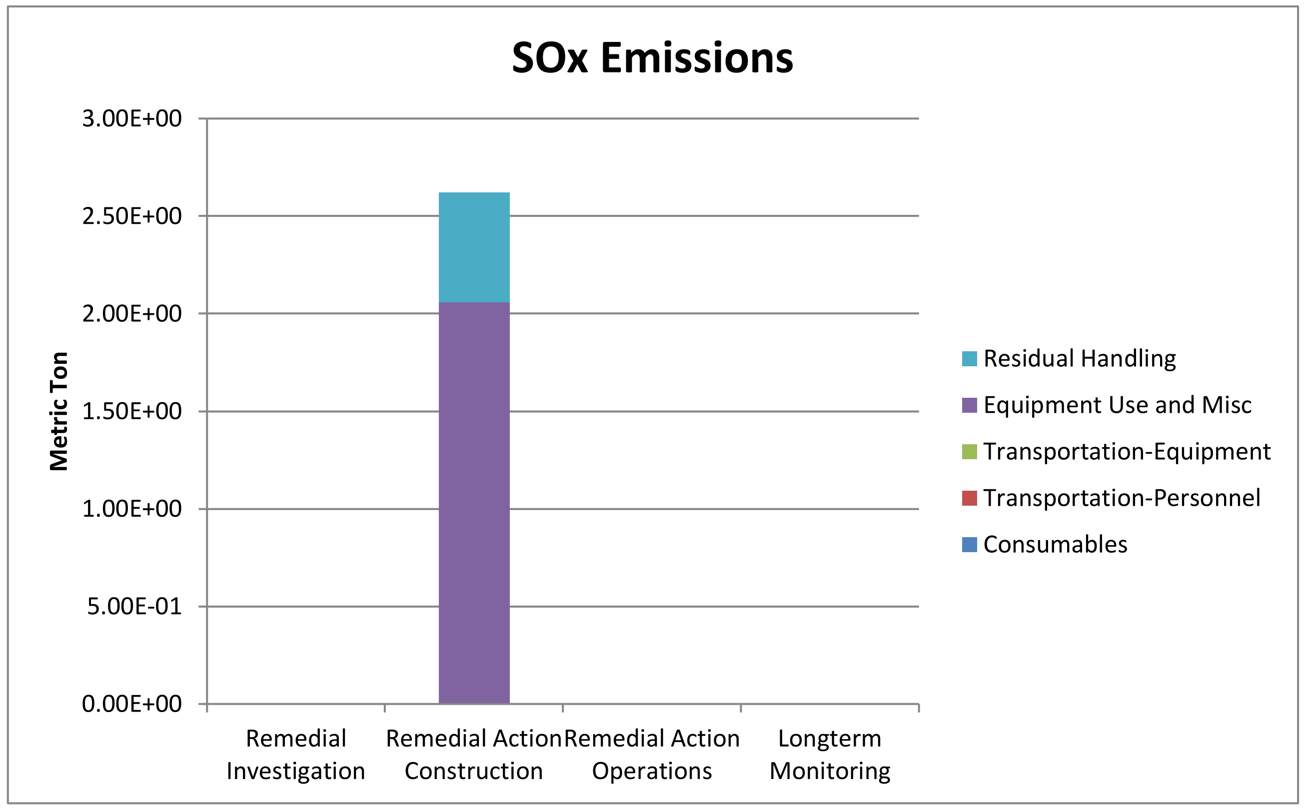
Total Cost with Footprint Reduction
$0

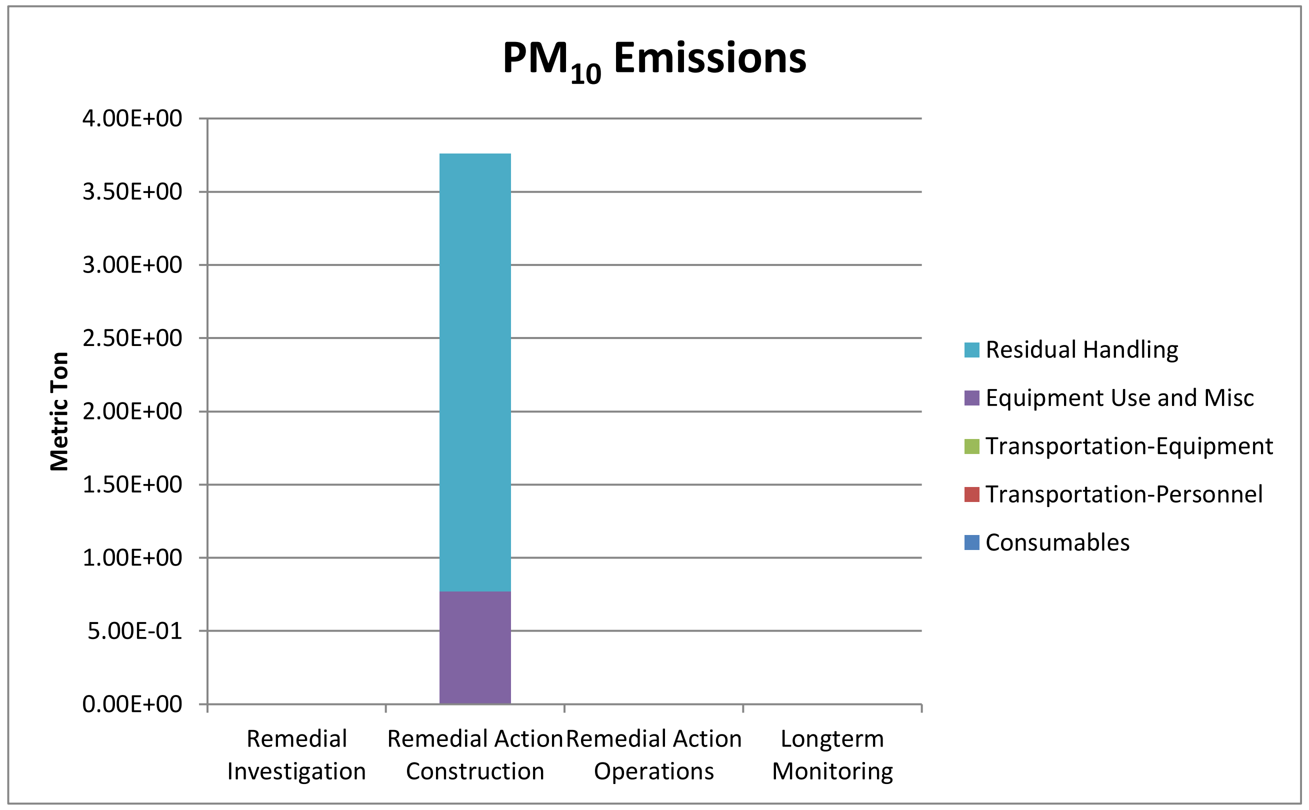

GHG Emissions
Metric Tons
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Total Energy Used
MMBTU
1.00E+05
9.00E+04
8.00E+04
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Water Consumption
Gallons
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
1.00E+01
9.00E+00
8.00E+00
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
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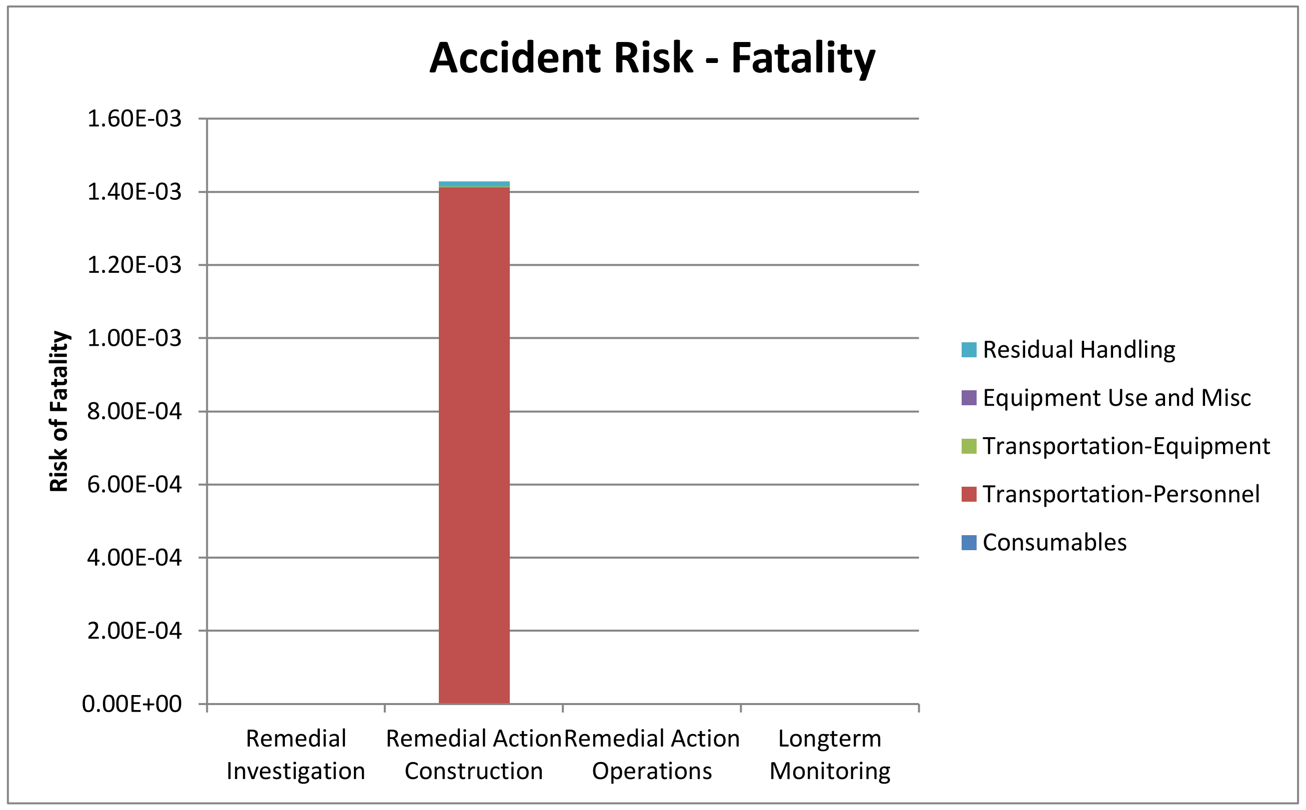
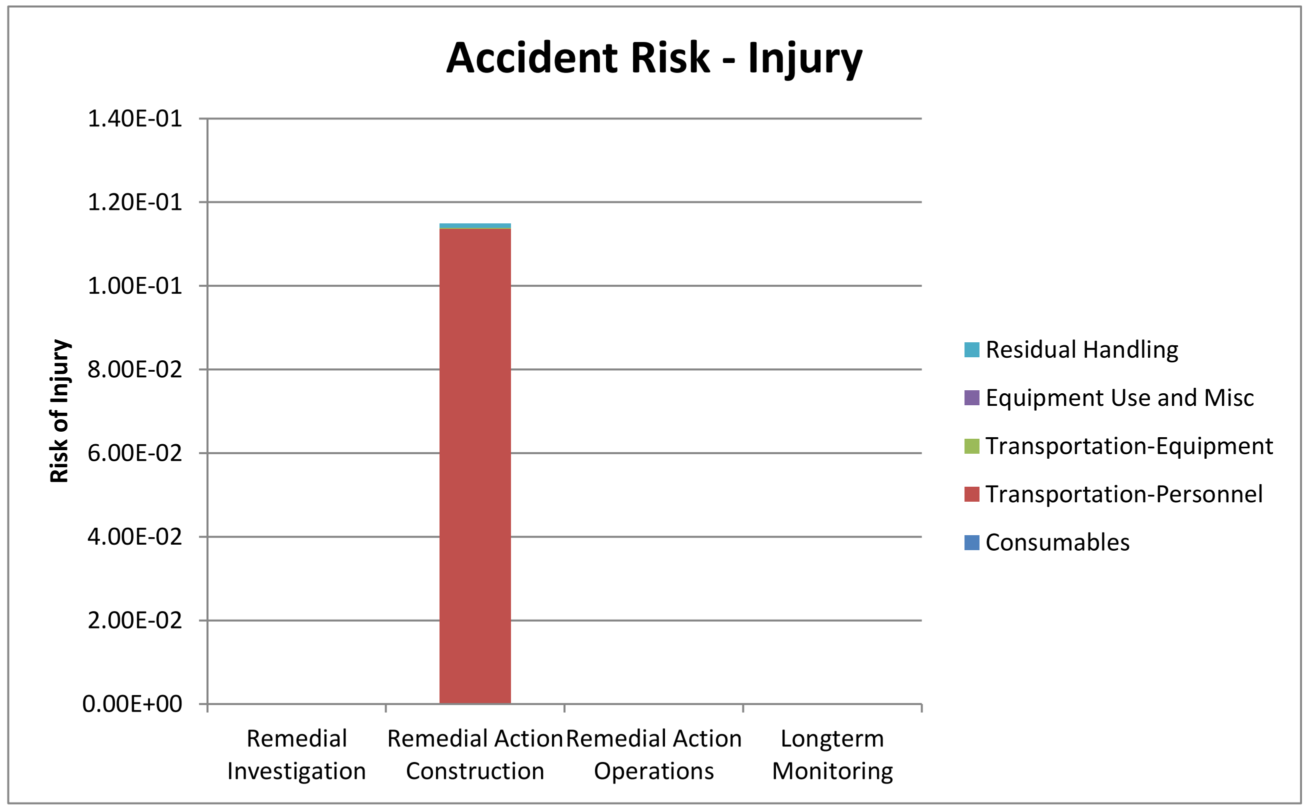
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
1.60E-03
1.40E-03
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

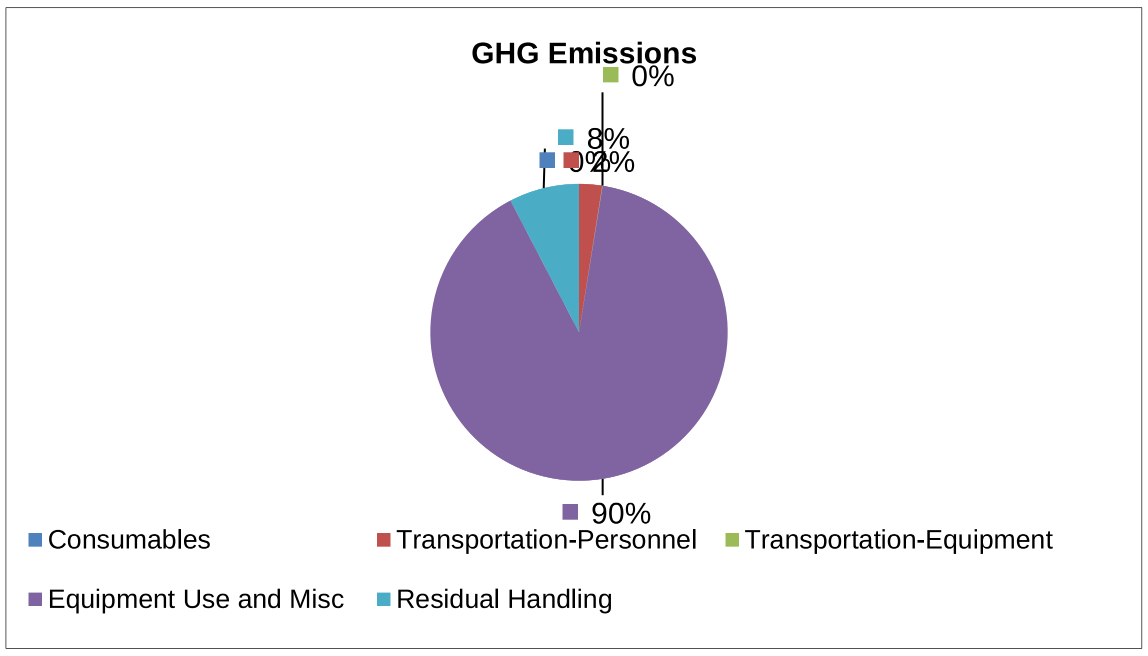

Accident Risk - Injury
Risk of Injury
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

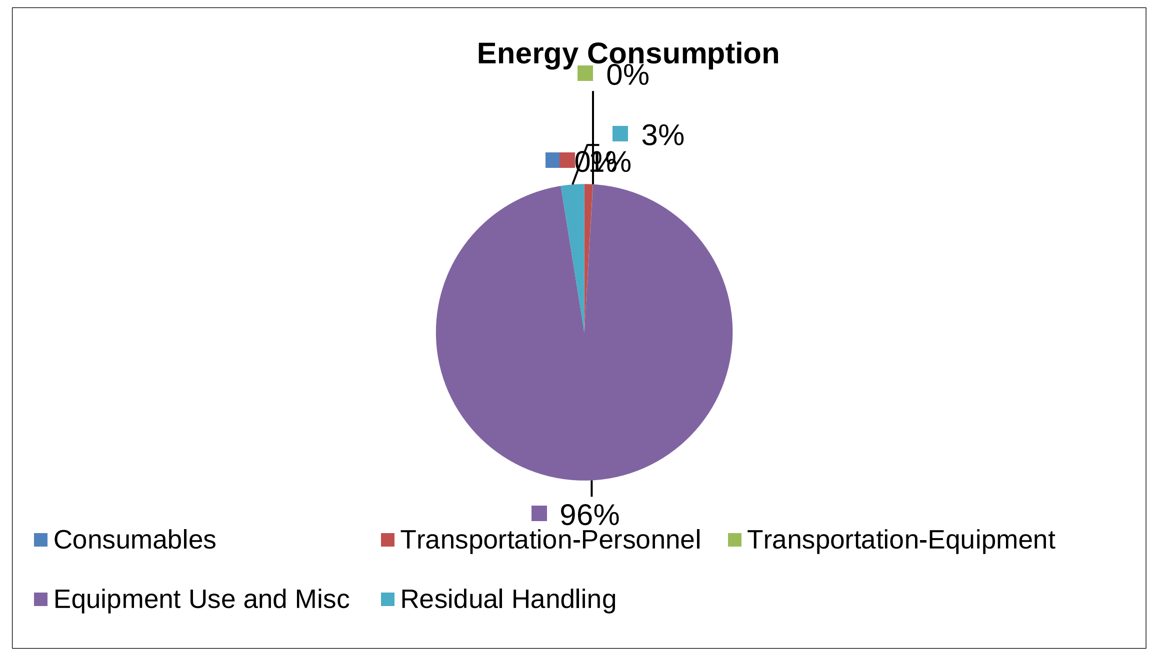
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	High Visibility - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	139.75	lbs	0.31	0.16	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	RCRA Cap, Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	10,938.00	lbs	24.41	12.90	0.03	0.09	0.00	0.05	0.01	143.14	3.93
RAC	RCRA Cap, Geotextile	HDPE	geotextile, use HDPE, 80-mil	105,000.00	lbs	234.33	123.81	0.30	0.90	0.00	0.52	0.08	1374.07	37.74
RAC	RCRA Cap, Compacted Clay	Bentonite	compacted clay	46,000,000.00	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	RCRA Cap	Gravel		19,502,000.00	lbs	150.36	150.36	0.00	0.00	0.00	0.00	0.00	3583.78	0.00
RAC	Solidification - Portland Cement	Typical Cement		2,167,900.00	lbs	816.03	816.03	0.00	0.00	0.00	0.00	0.00	6108.55	0.00
RAC	Clean Fill	Soil	assume top soil	47,780,000.00	lbs	498.39	498.39	0.00	0.00	0.00	0.00	0.00	13170.42	0.00
RAC	Top Soil	Soil	assume top soil	1,160,000.00	lbs	12.10	12.10	0.00	0.00	0.00	0.00	0.00	319.75	0.00
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,020.70	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.88	1.82
	Subtotal					**1771.15**	**1634.73**	**0.36**	**1.12**	**0.00**	**0.65**	**0.09**	**24969.37**	**48.42**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Solidification	Drill Rig, HSA (diesel)	80% utilization	4,480.00	hrs	248.56	244.01	0.00	0.22	2.86	0.05	0.18	1140.63	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		2,688.00	hrs	472.44	472.44	0.00	0.00	3.25	0.87	0.27	2343.32	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		5,376.00	hrs	109.09	109.09	0.00	0.00	1.00	0.20	0.13	459.90	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	2,688.00	hrs	161.18	161.18	0.00	0.00	1.07	0.29	0.11	865.06	
	Subtotal					**1014.79**	**1010.16**	**0.00**	**0.22**	**8.36**	**1.42**	**0.71**	**4922.53**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**2,786**	**2,645**	**0.36**	**1.34**	**8.36**	**2.07**	**0.81**	**29,892**	**48**

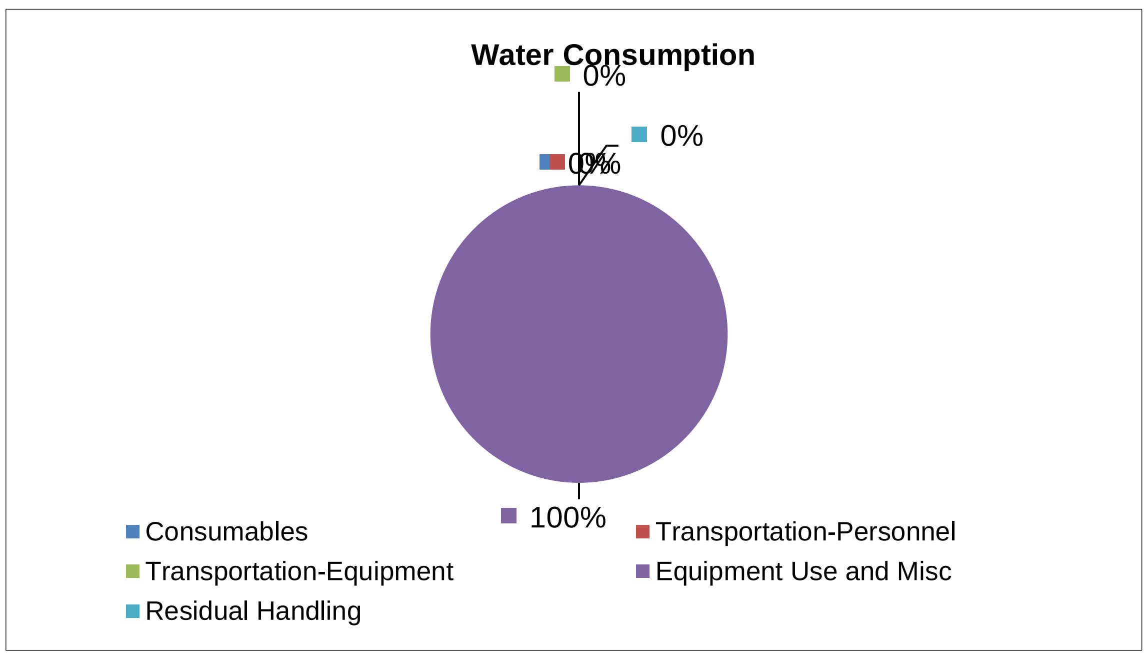
Alternative 1
Values Input into SiteWise as "Other"

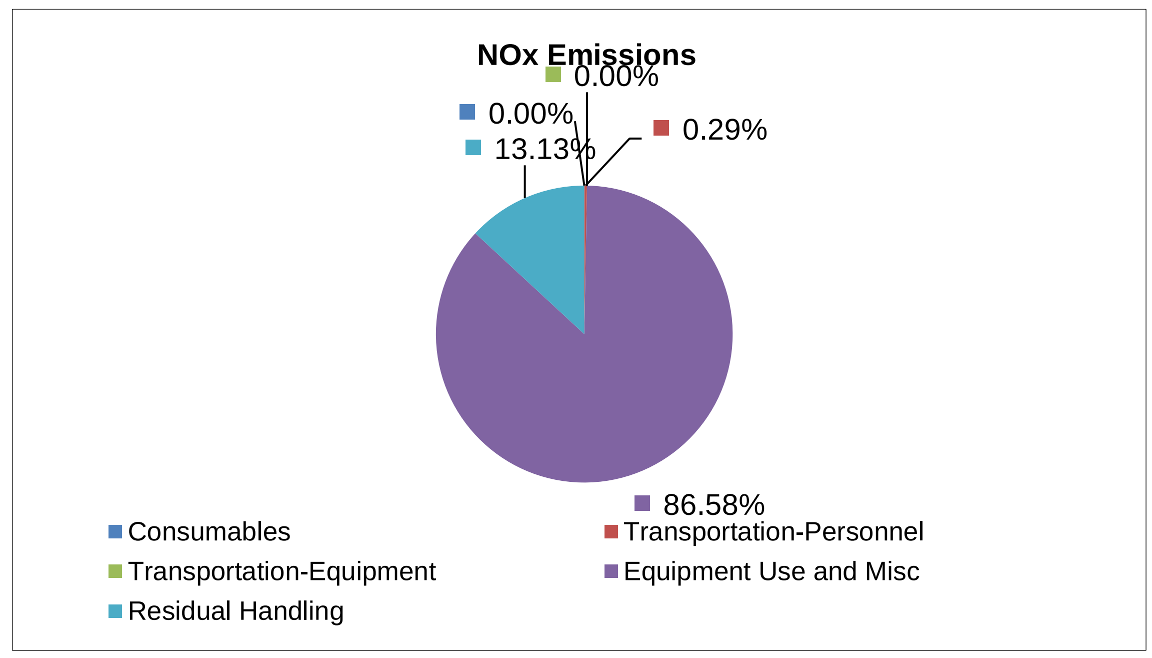
Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	2,785.93	2,644.89	112.96	28.08	8.36	2.07	0.81	101,991.16	48,420.72
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

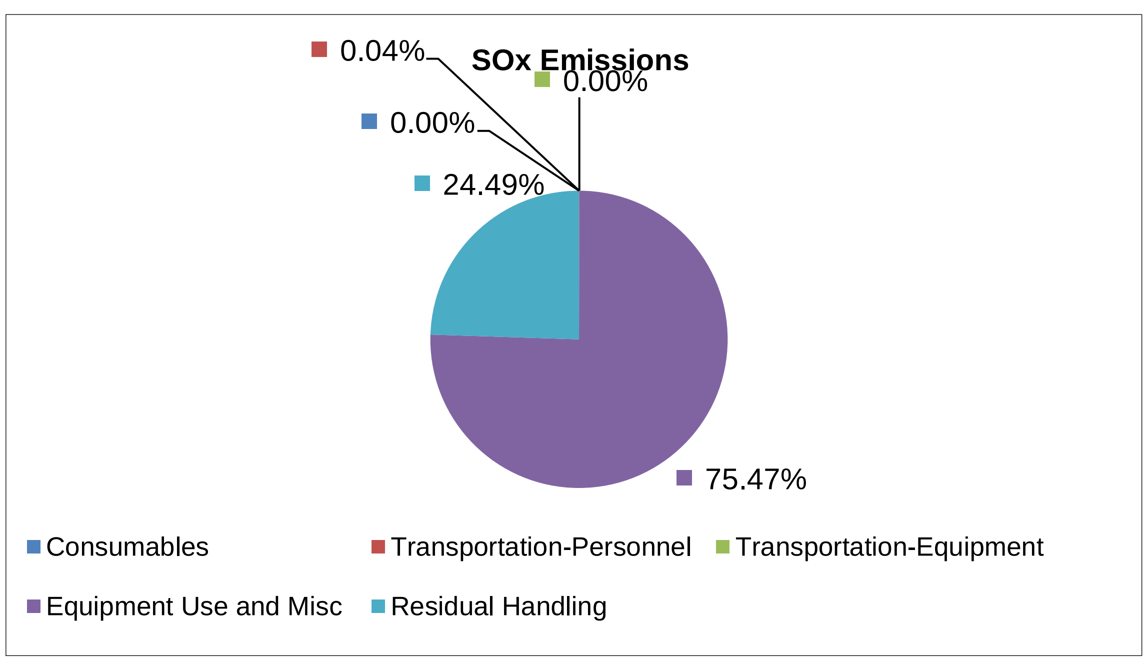
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

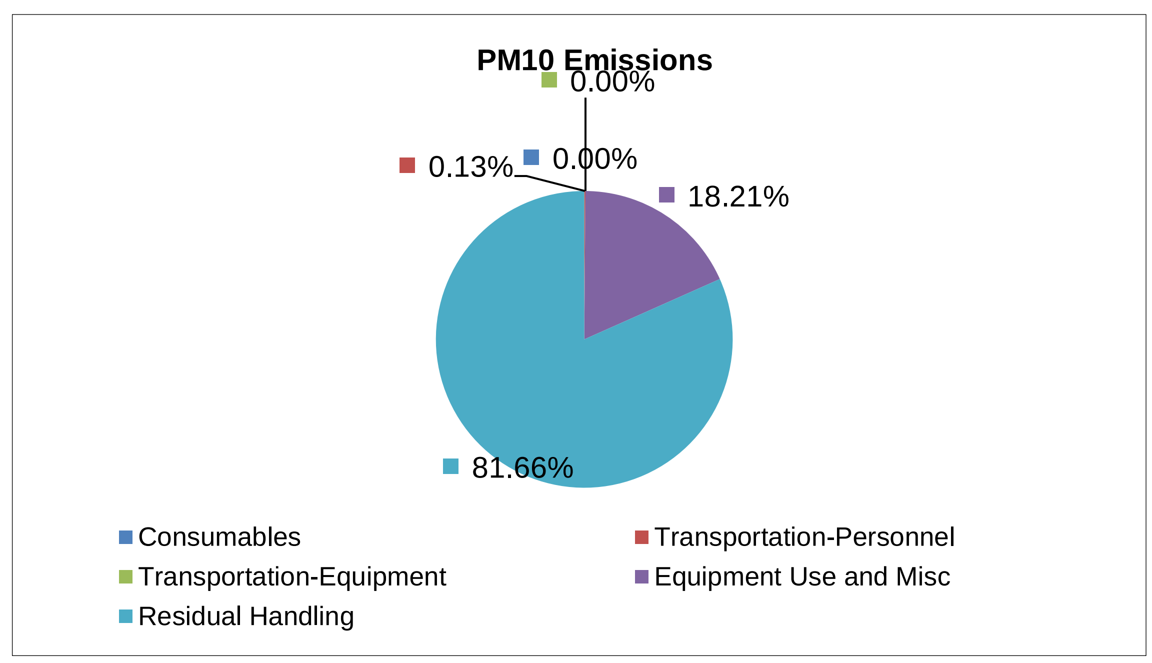

GHG Emissions
0%
8%
0%
2%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

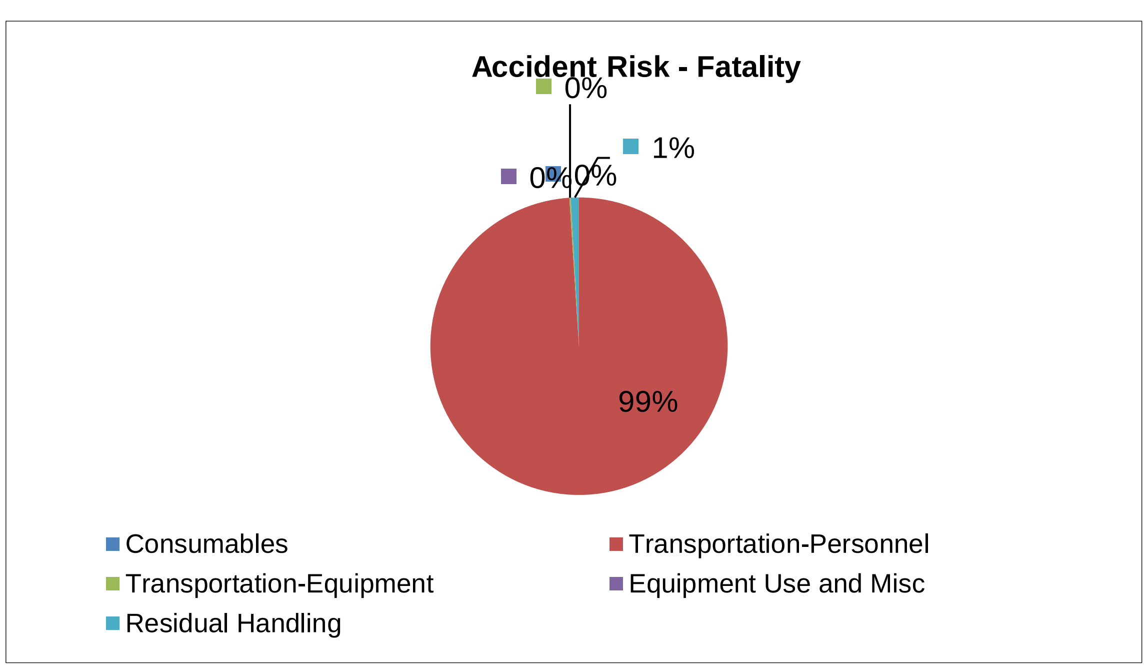

Energy Consumption
0%
3%
0%
1%
96%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

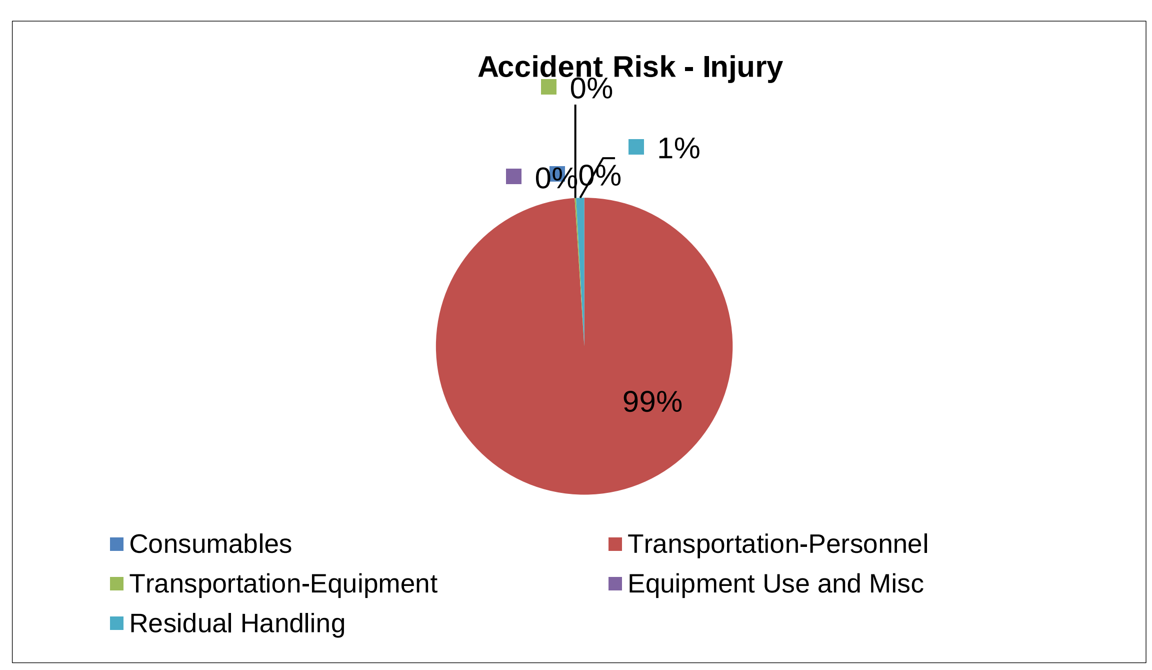

Water Consumption
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.00%
0.29%
13.13%
86.58%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.04%
0.00%
0.00%
24.49%
75.47%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
0.13%
0.00%
18.21%
81.66%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

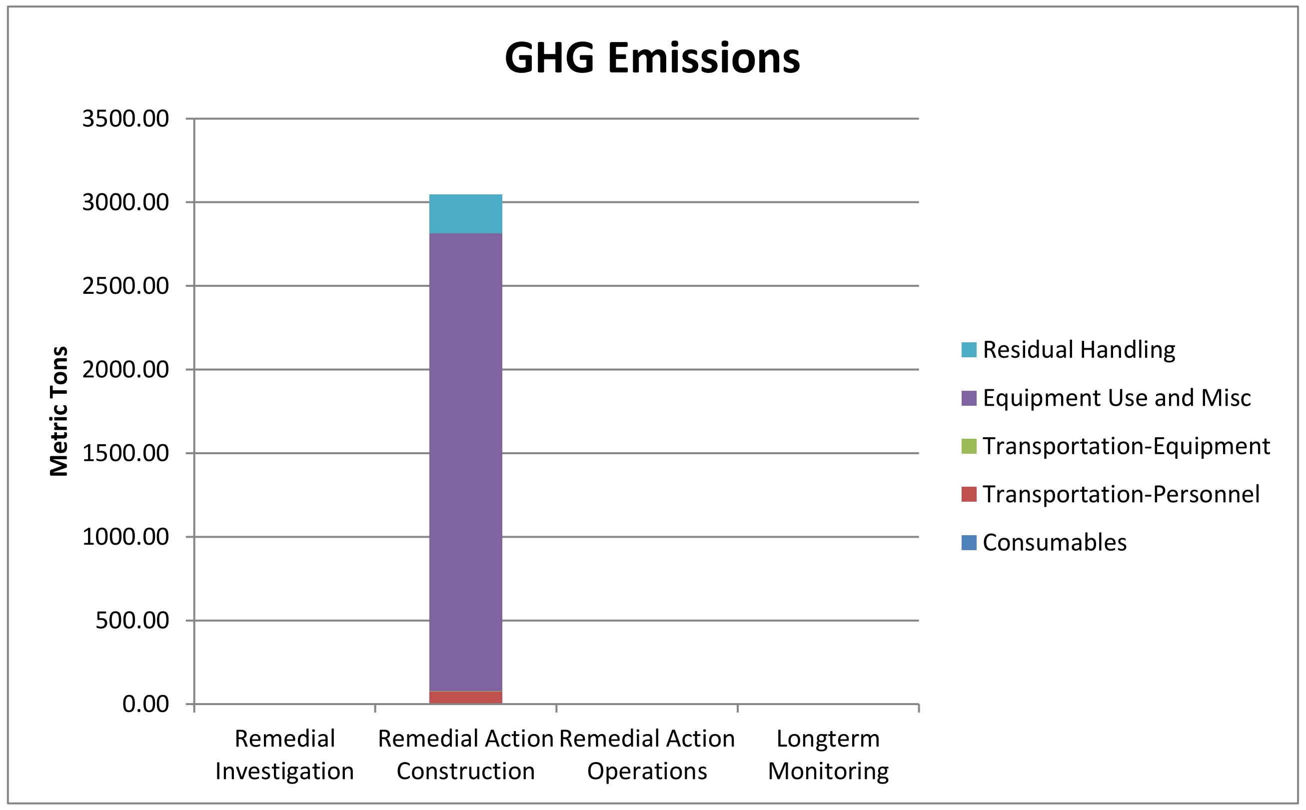

Accident Risk - Injury
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

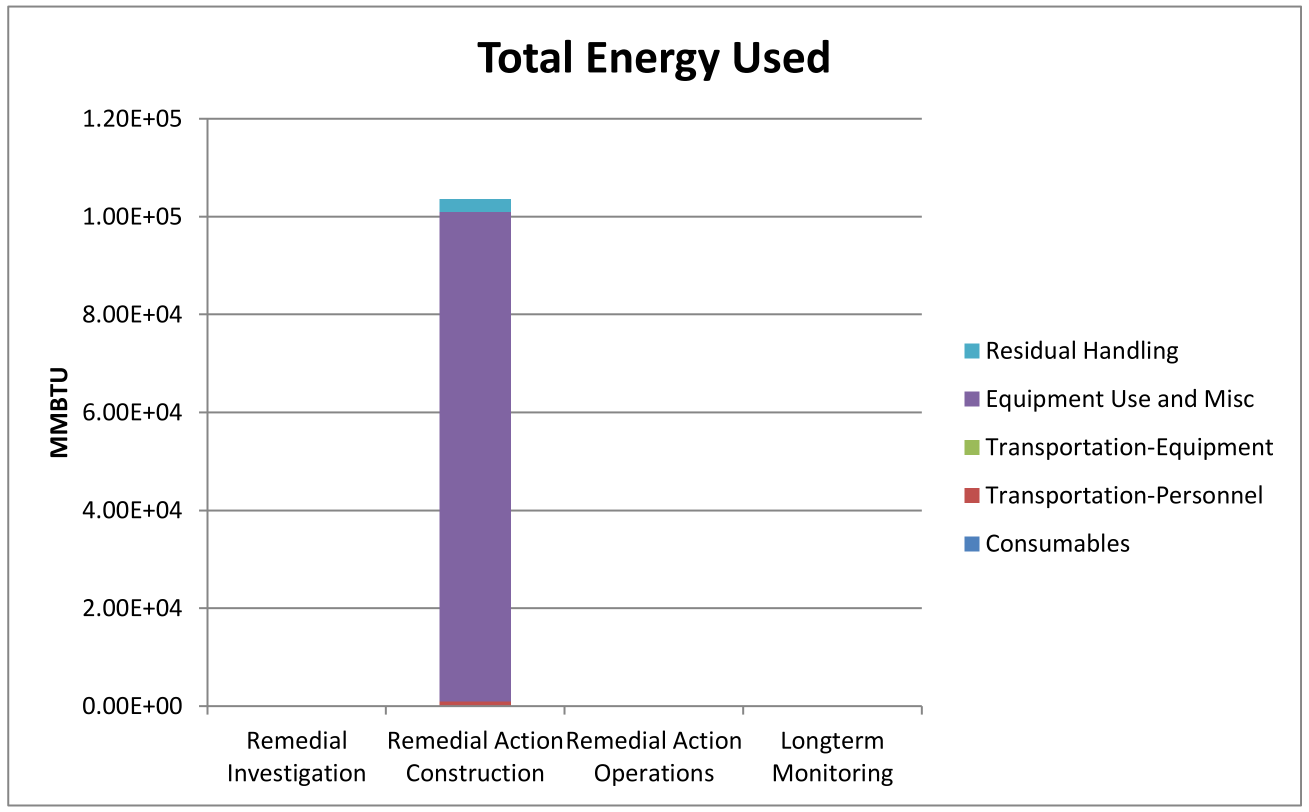
Sustainable Remediation - Environmental Footprint Summary

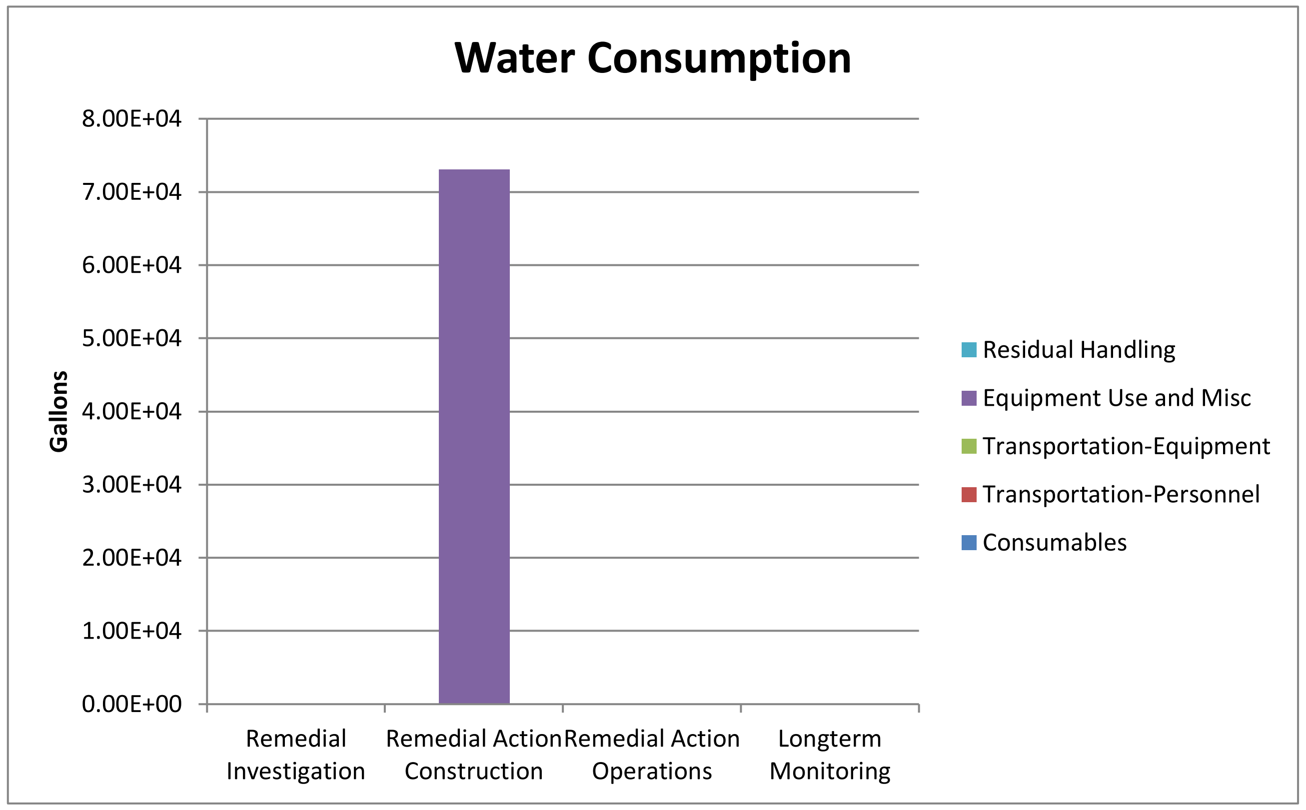
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	76.55	9.6E+02	NA	2.8E-02	1.0E-03	5.7E-03	1.6E-03	1.3E-01
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	2,738.05	1.0E+05	7.3E+04	8.4E+00	2.1E+00	8.1E-01	0.0E+00	0.0E+00
	Residual Handling	232.47	2.6E+03	NA	1.3E+00	6.8E-01	3.6E+00	1.4E-05	1.1E-03
	Sub-Total	3,047.99	1.04E+05	7.30E+04	9.70E+00	2.78E+00	4.45E+00	1.58E-03	1.27E-01
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**3.0E+03**	**1.0E+05**	**7.3E+04**	**9.7E+00**	**2.8E+00**	**4.4E+00**	**1.6E-03**	**1.3E-01**

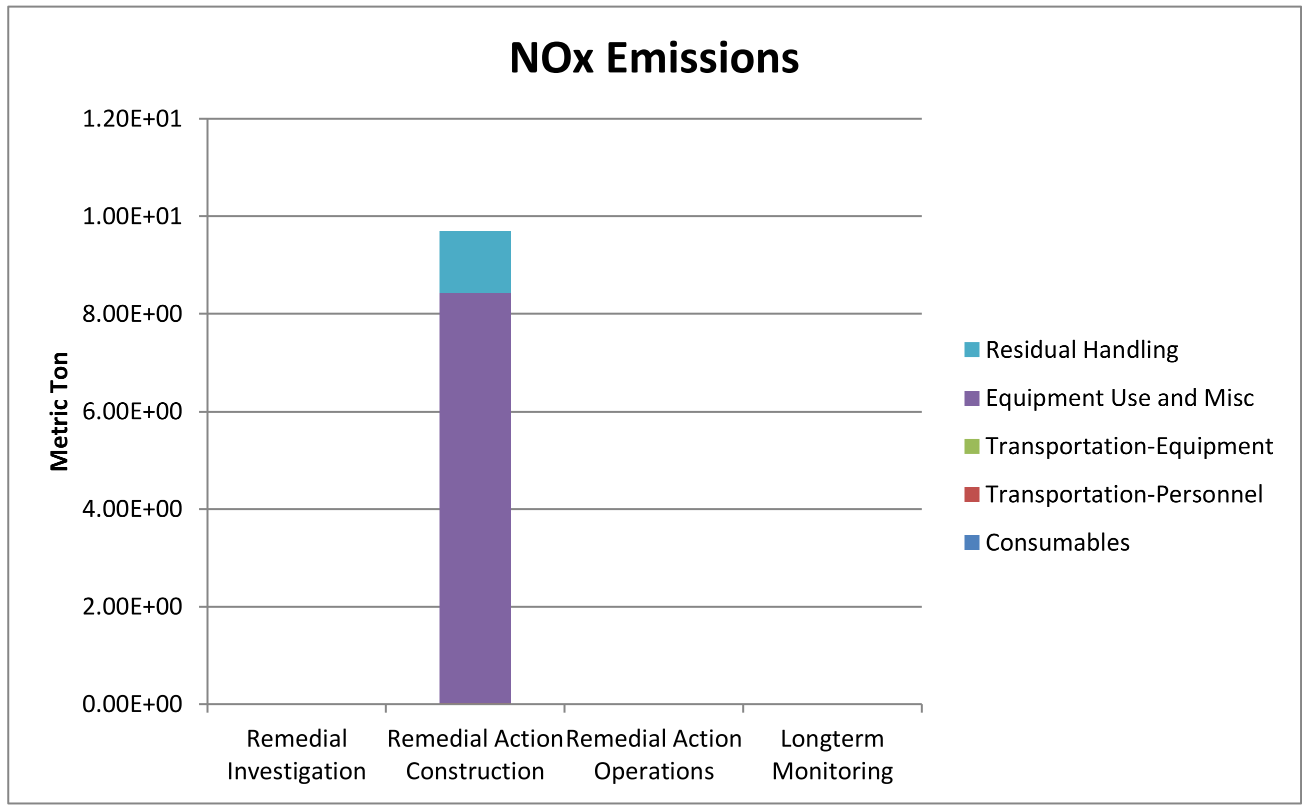
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.4E+04	5.4E+03	0.0E+00	0	1.0E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**1.4E+04**	**5.4E+03**	**0.0E+00**	**$0**	**1.0E+00**

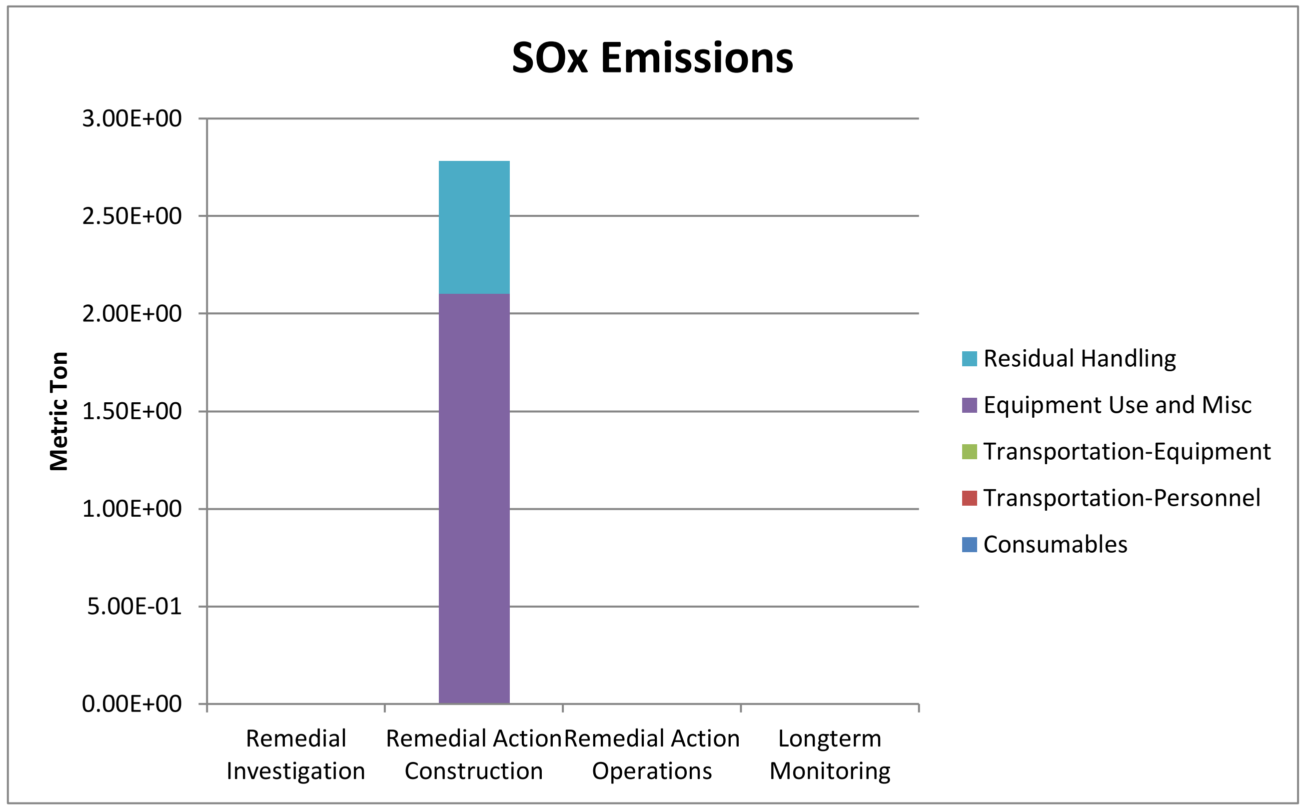
Total Cost with Footprint Reduction
$0

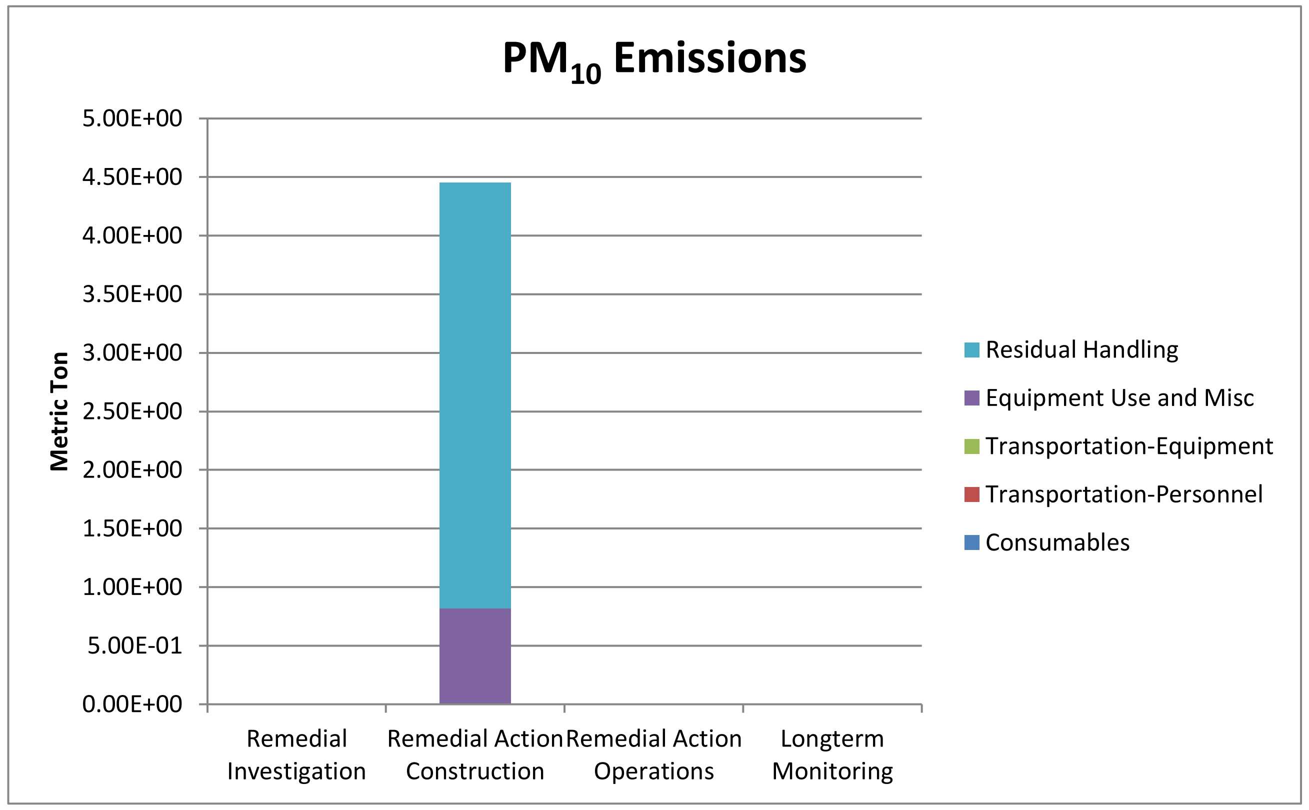

GHG Emissions
Metric Tons
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Total Energy Used
MMBTU
1.20E+05
1.00E+05
8.00E+04
6.00E+04
4.00E+04
2.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Water Consumption
Gallons
8.00E+04
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
1.20E+01
1.00E+01
8.00E+00
6.00E+00
4.00E+00
2.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM10 Emissions
Metric Ton
5.00E+00
4.50E+00
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
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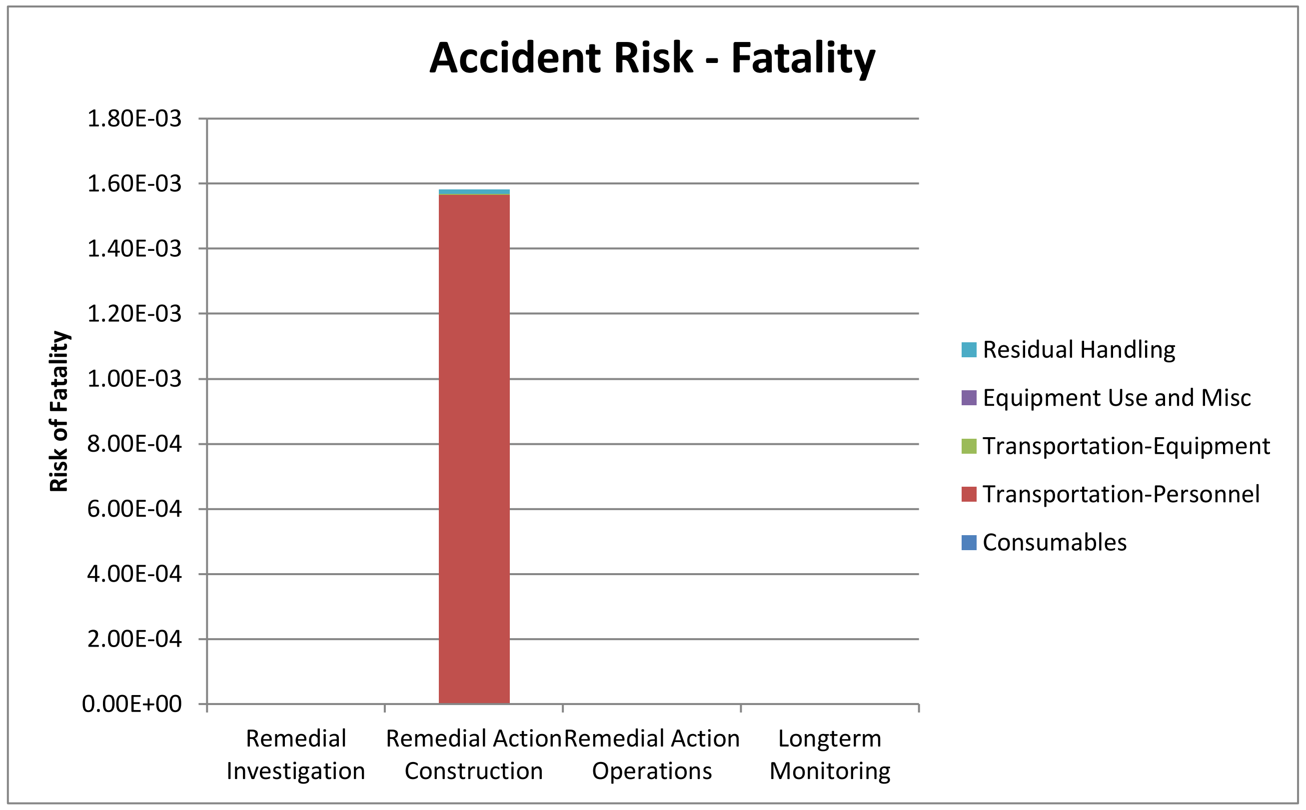
Accident Risk - Fatality
Risk of Fatality
1.80E-03
1.60E-03
1.40E-03
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
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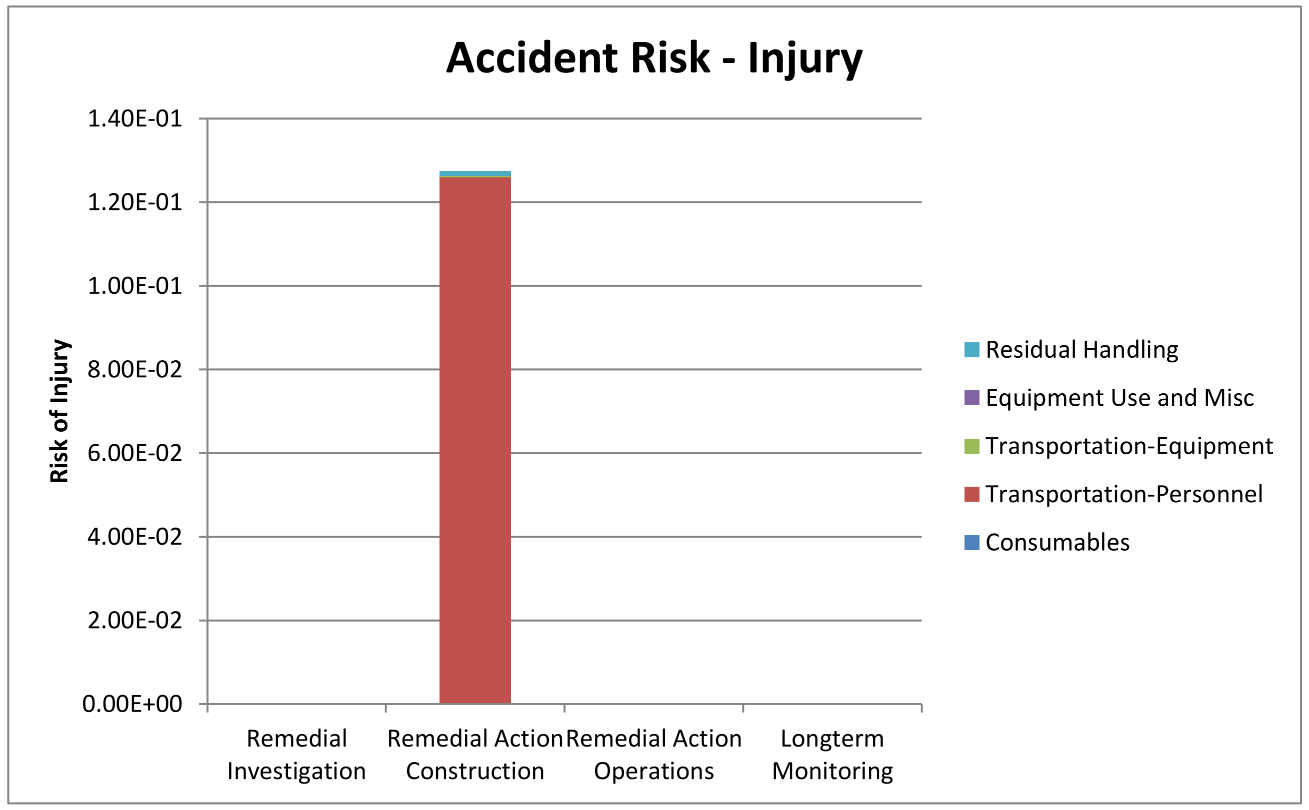
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

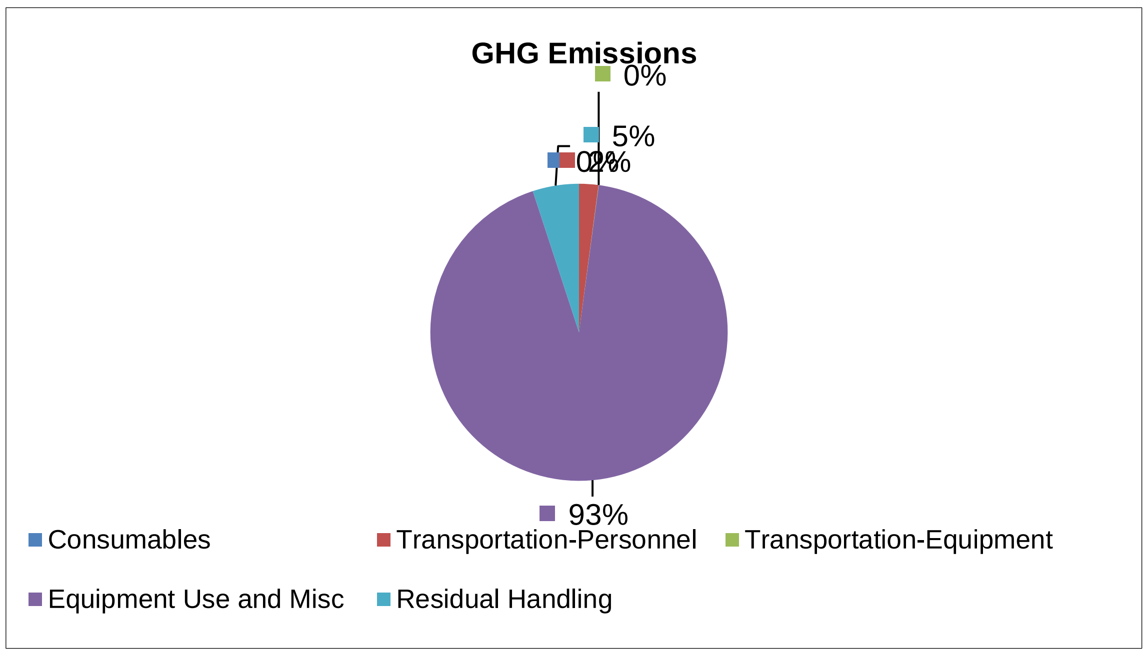

Accident Risk - Injury
Risk of Injury
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

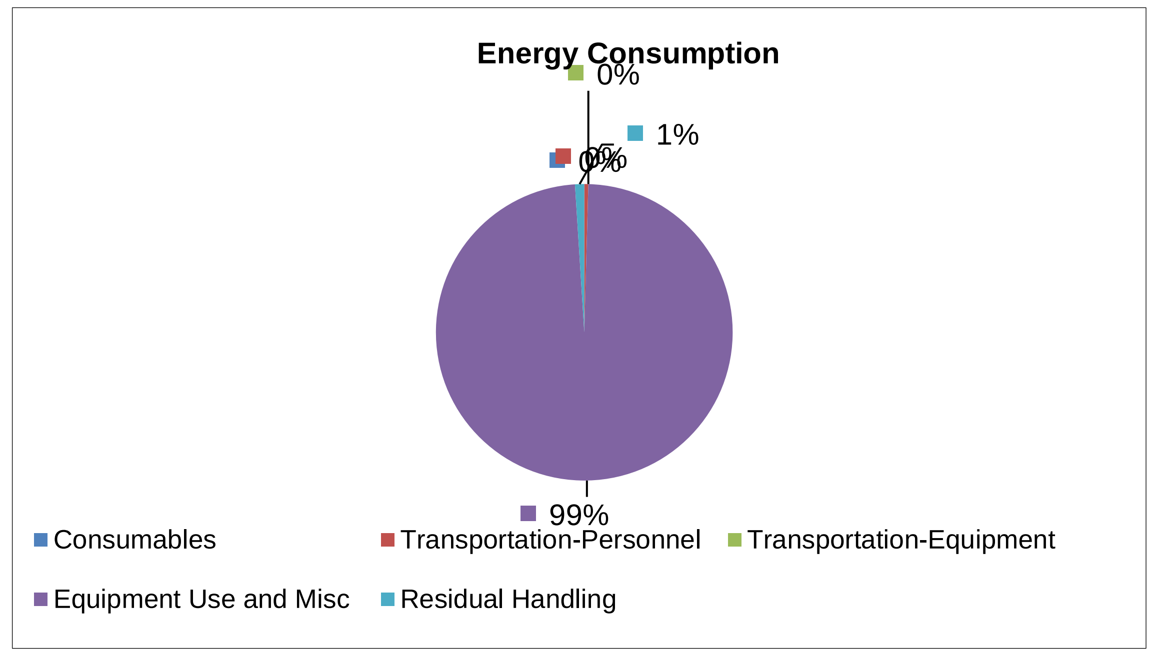
						Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Air Sparge/Solvent Injection Wells, 1" dia	PVC	1 inch dia, PVC, 0.33 lbs/ft	6,680.00	lft	4.97	2.50	0.01	0.03	0.00	0.01	0.00	91.15	3.79
RAC	Product Recovery Wells	PVC	1 inch dia, PVC, 0.33 lbs/ft	416.00	lft	0.31	0.16	0.00	0.00	0.00	0.00	0.00	5.68	0.24
RAC	Piping	PVC	1 inch HDPE, 0.22 lbs/ft	417.00	lft	0.21	0.10	0.00	0.00	0.00	0.00	0.00	3.79	0.16
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	High Visibility - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	139.75	lbs	0.31	0.16	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	RCRA Cap - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	10,938.00	lbs	24.41	12.90	0.03	0.09	0.00	0.05	0.01	143.14	3.93
RAC	RCRA Cap - 80-mil poly	HDPE	geotextile, use HDPE, 80-mil	105,000.00	lbs	234.33	123.81	0.30	0.90	0.00	0.52	0.08	1374.07	37.74
RAC	RCRA Cap - gravel	Gravel		19,502,000.00	lbs	150.36	150.36	0.00	0.00	0.00	0.00	0.00	3583.78	0.00
RAC	RCRA Cap - gravel	Bentonite		46,000,000.00	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Portland Cement	Typical Cement		1,223,600.00	lbs	460.58	460.58	0.00	0.00	0.00	0.00	0.00	3447.77	0.00
RAC	Clean Fill	Soil	assume top soil	47,780,000.00	lbs	498.39	498.39	0.00	0.00	0.00	0.00	0.00	13170.42	0.00
RAC	Top Soil	Soil	assume top soil	1,160,000.00	lbs	12.10	12.10	0.00	0.00	0.00	0.00	0.00	319.75	0.00
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,021.00	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.89	1.82
RAC	Solvent	Vegetable Oil	solvent	7,920,000.00	lbs	1185.33	1185.31	0.00	0.00	0.00	1.18	0.00	41236.80	3577.60
RAC	Building, floor	General Concrete		58,000.00	lbs	3.42	3.42	0.00	0.00	0.00	0.00	0.00	33.75	0.00
RAC	Building, walls	General Concrete		36,000.00	lbs	2.12	2.12	0.00	0.00	0.00	0.00	0.00	20.95	0.00
RAC	Building, walls	Bentonite	mortar	1,620.00	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Building, sand	Sand		6,300.00	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.39	0.00
RAC	Air Sparge/Solvent Injection Head Completion	PVC	203 well heads, Assume PVC, 5 lb per head	1,015.00	lbs	2.29	1.15	0.00	0.01	0.00	0.00	0.00	41.97	1.75
RAC	Product Recovery Well Head	PVC	5 well heads, Assume PVC, 5 lb per head	105.00	lbs	0.24	0.12	0.00	0.00	0.00	0.00	0.00	4.34	0.18
	Subtotal					**2614.59**	**2474.17**	**0.37**	**1.16**	**0.00**	**1.84**	**0.10**	**63747.41**	**3632.13**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		2,688.00	hrs	472.44	472.44	0.00	0.00	3.25	0.87	0.27	2343.32	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		5,376.00	hrs	109.09	109.09	0.00	0.00	1.00	0.20	0.13	459.90	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	2,688.00	hrs	161.18	161.18	0.00	0.00	1.07	0.29	0.11	865.06	
RAC	Drill Rig	Drill Rig, HSA (diesel)		3,456.00	hrs	191.75	188.24	0.00	0.17	2.20	0.04	0.14	879.92	
	Subtotal					**957.97**	**954.38**	**0.00**	**0.17**	**7.71**	**1.41**	**0.67**	**4661.81**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**3,573**	**3,429**	**0.37**	**1.33**	**7.71**	**3.25**	**0.77**	**68,409**	**3,632**

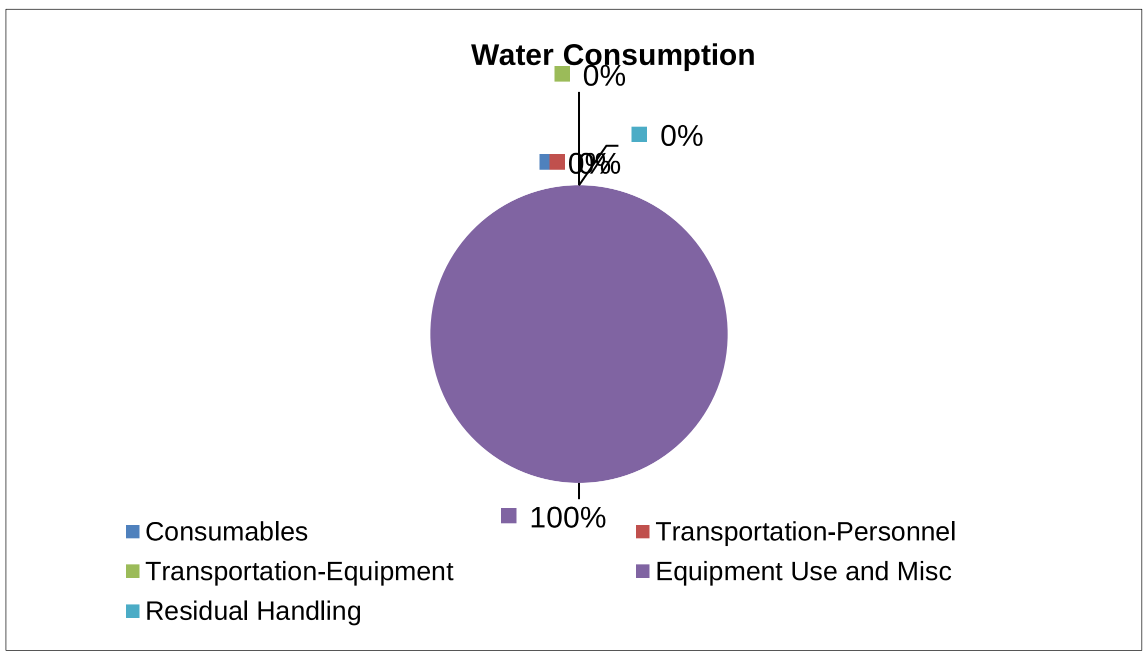
Alternative 1
Values Input into SiteWise as "Other"

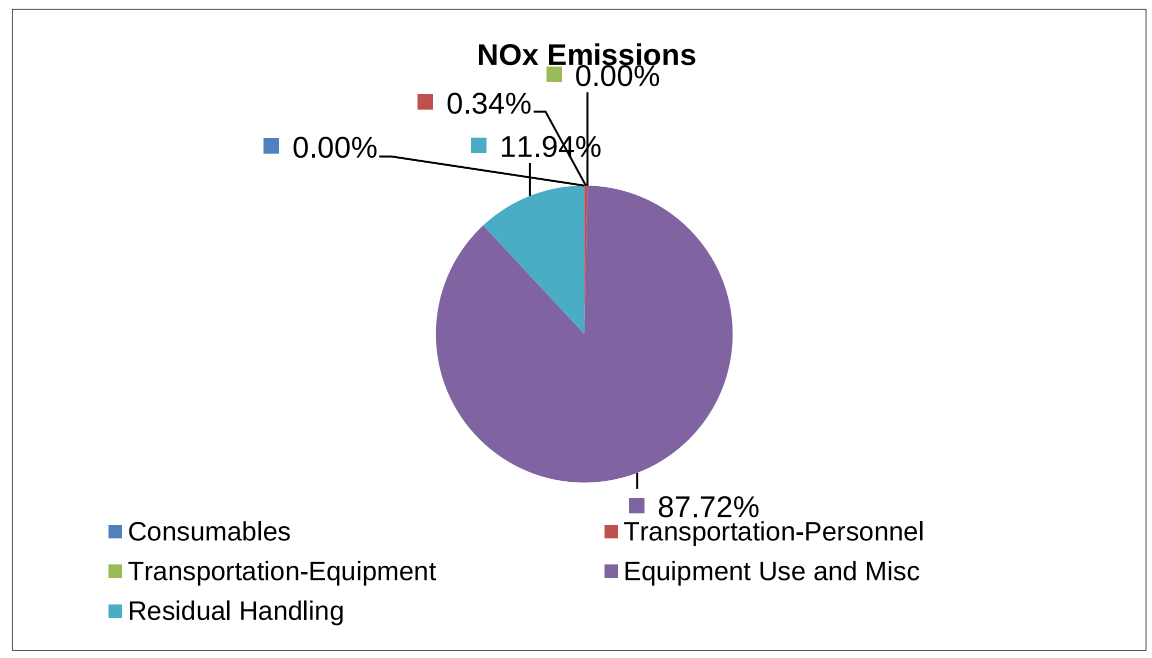
Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	3,572.33	3,428.44	115.90	27.99	7.71	3.25	0.77	233,397.45	3,631,952.32
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

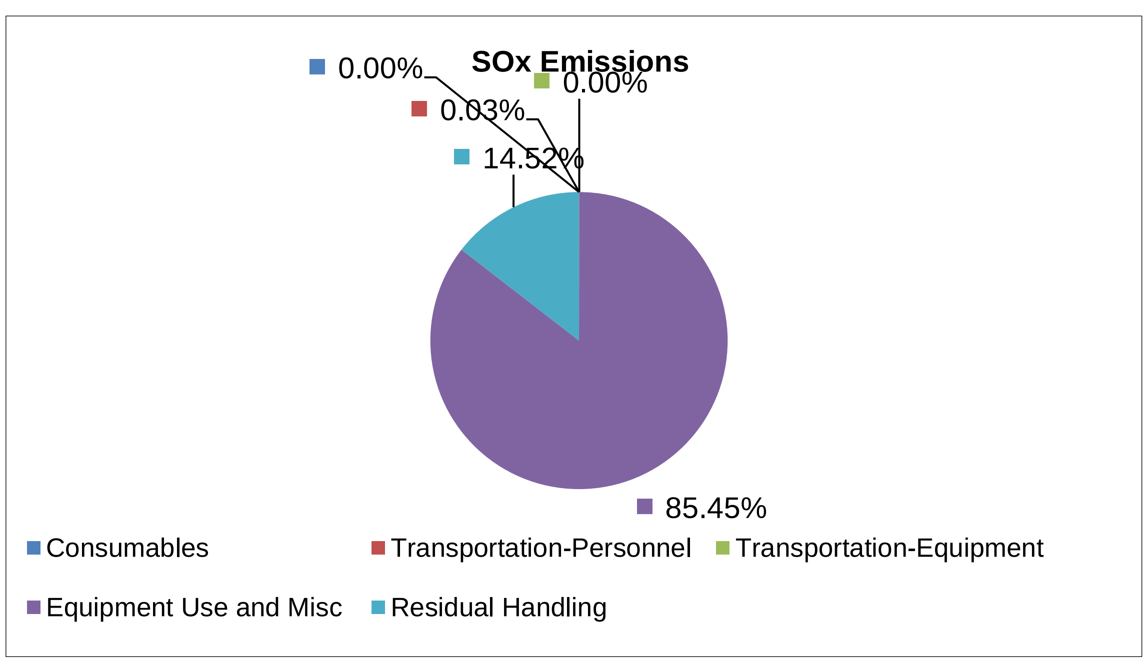
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

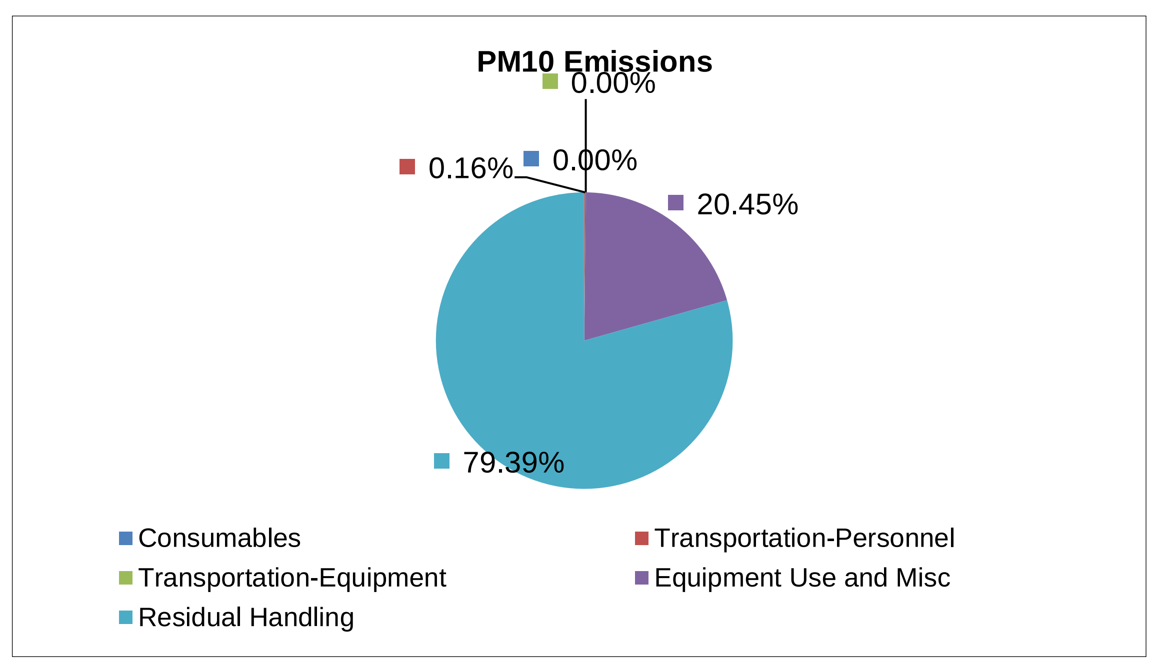

GHG Emissions
0%
5%
0%
2%
93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

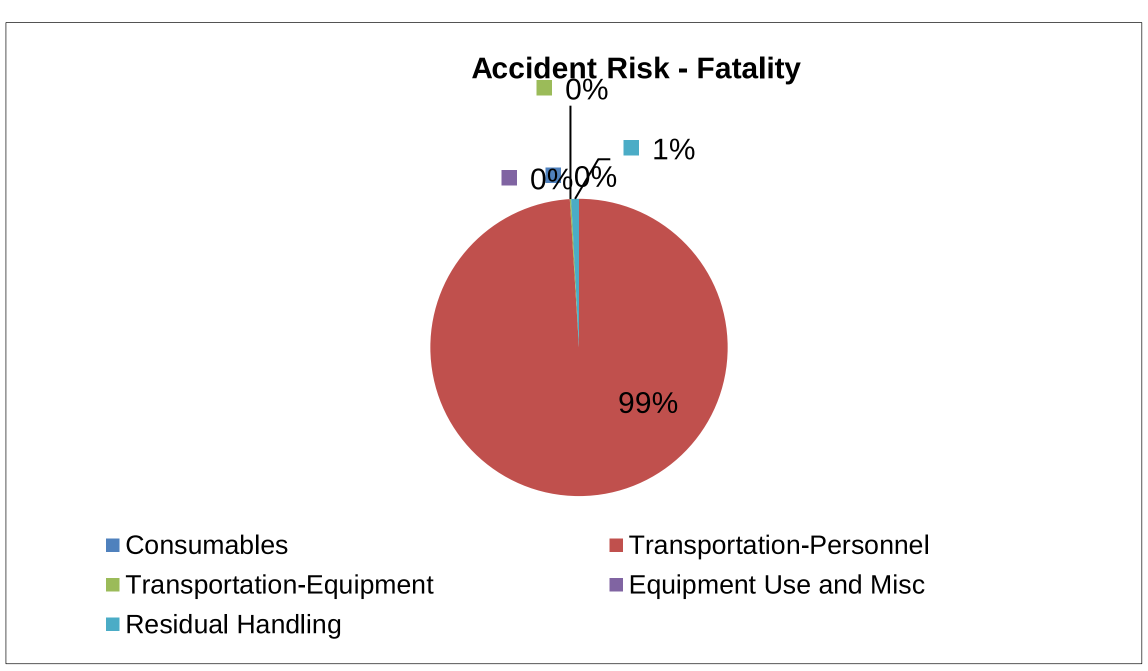

Energy Consumption
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

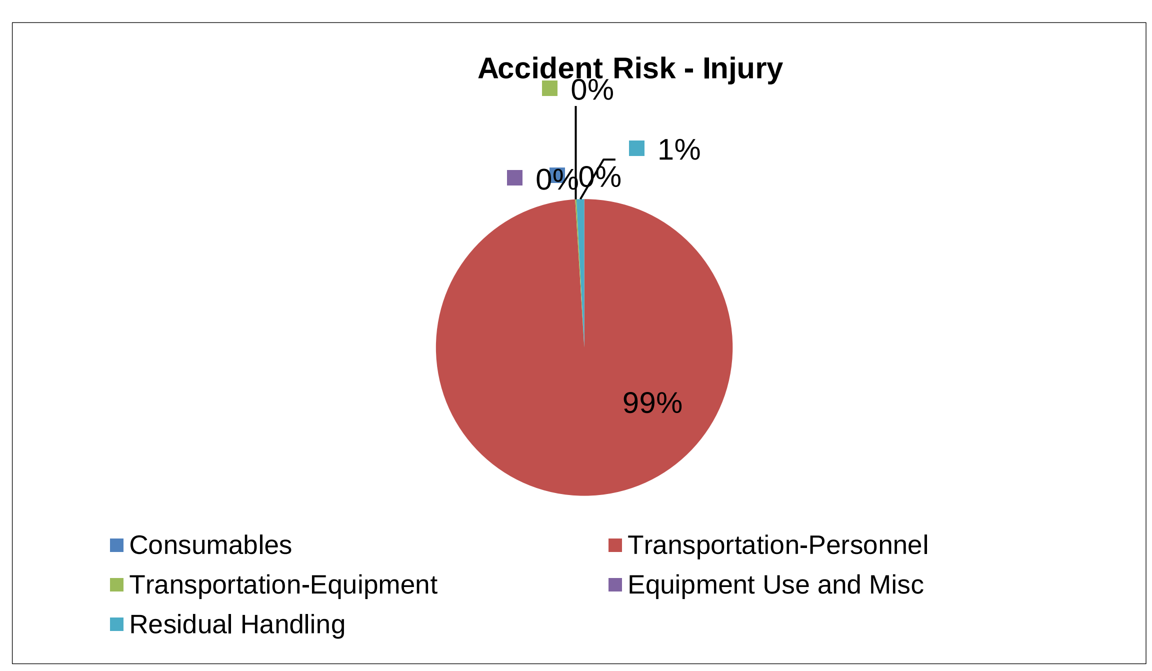

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.34%
0.00%
11.94%
87.72%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
0.03%
0.00%
14.52%
85.45%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
0.16%
0.00%
20.45%
79.39%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

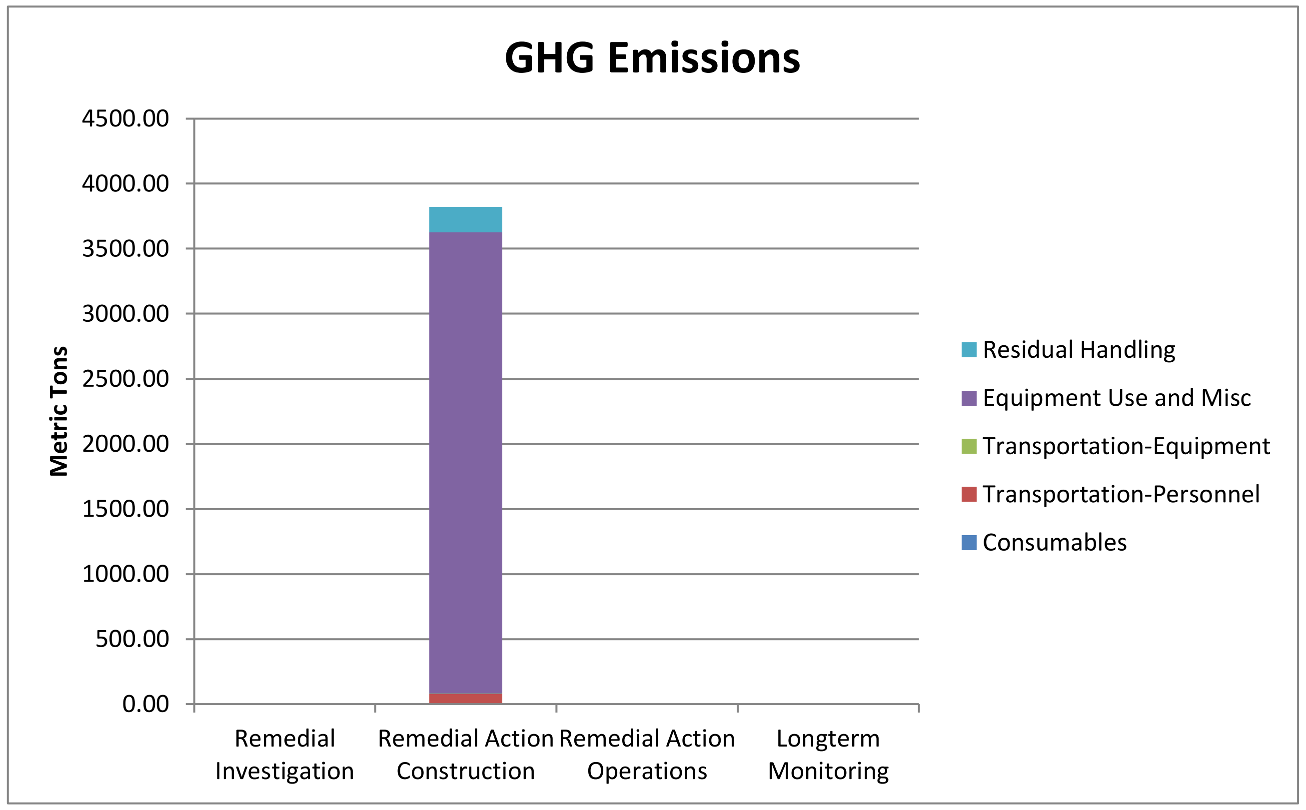

Accident Risk - Injury
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

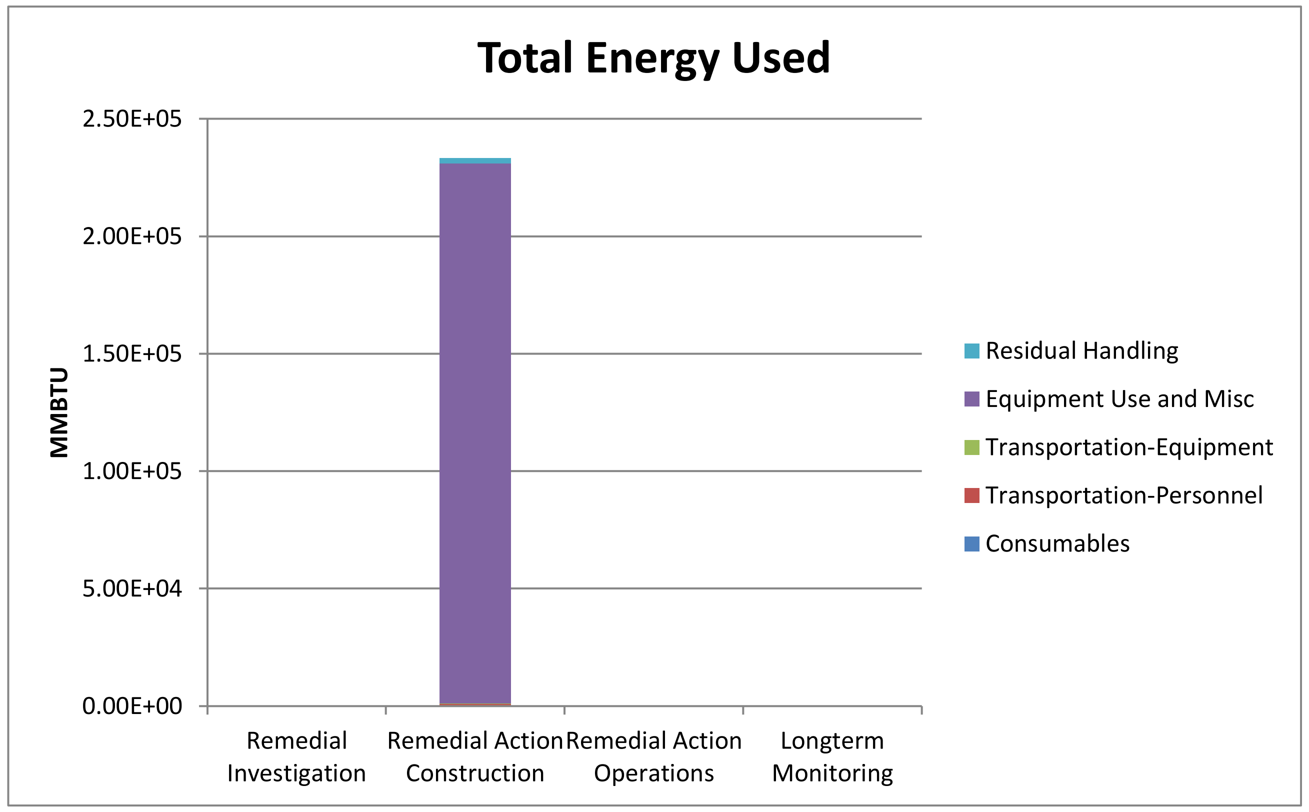
Sustainable Remediation - Environmental Footprint Summary

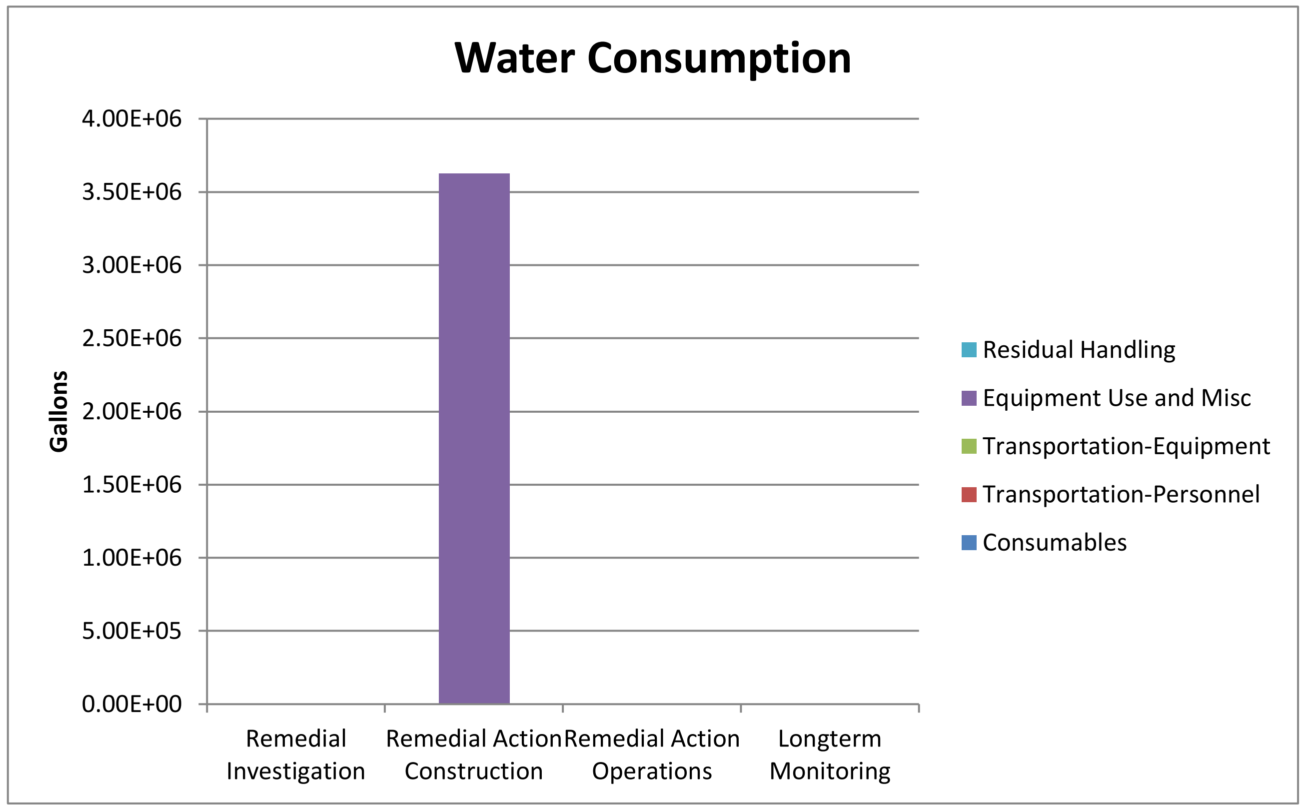
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	80.36	1.0E+03	NA	3.0E-02	1.0E-03	6.0E-03	1.6E-03	1.3E-01
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	3,548.05	2.3E+05	3.6E+06	7.7E+00	3.3E+00	7.7E-01	0.0E+00	0.0E+00
	Residual Handling	192.22	2.3E+03	NA	1.0E+00	5.6E-01	3.0E+00	1.4E-05	1.1E-03
	Sub-Total	3,821.55	2.33E+05	3.63E+06	8.78E+00	3.86E+00	3.77E+00	1.66E-03	1.34E-01
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**3.8E+03**	**2.3E+05**	**3.6E+06**	**8.8E+00**	**3.9E+00**	**3.8E+00**	**1.7E-03**	**1.3E-01**

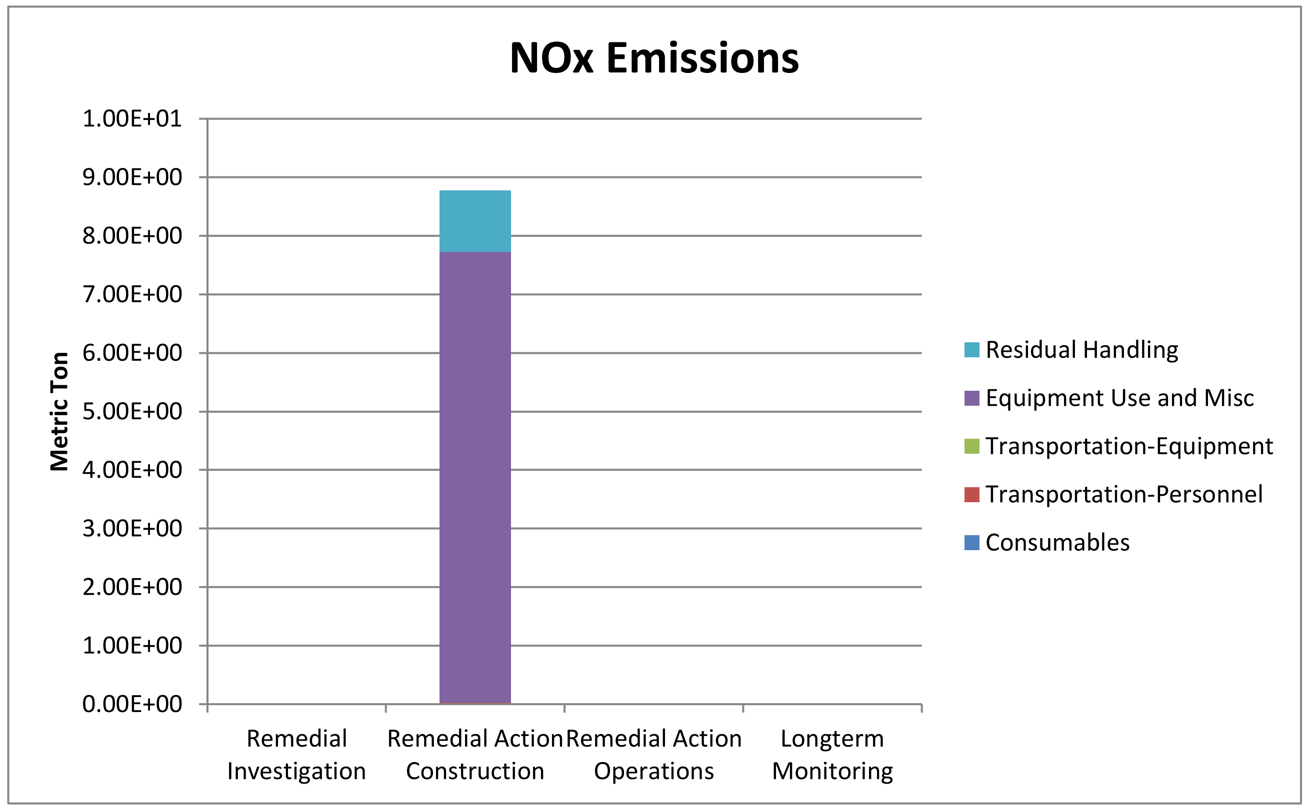
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.1E+04	5.4E+03	0.0E+00	0	1.1E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**1.1E+04**	**5.4E+03**	**0.0E+00**	**$0**	**1.1E+00**

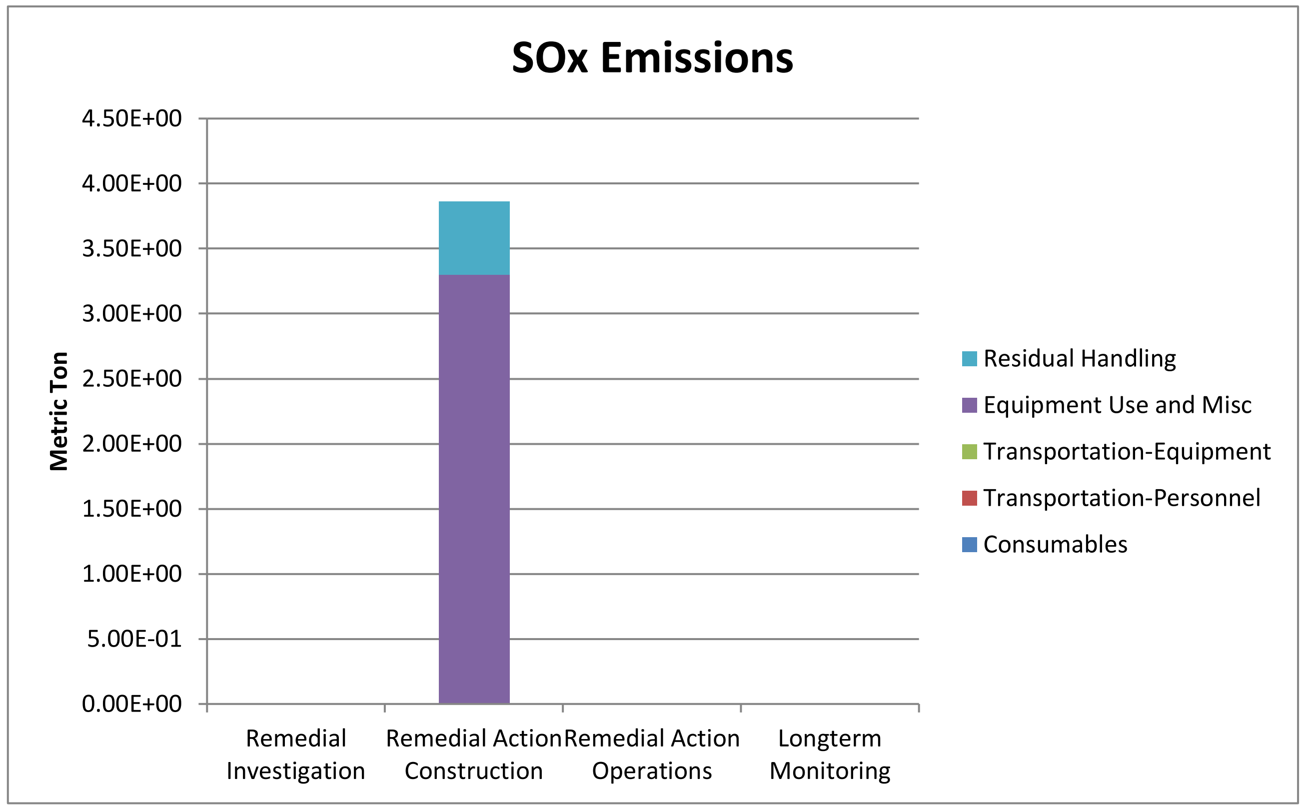
Total Cost with Footprint Reduction
$0

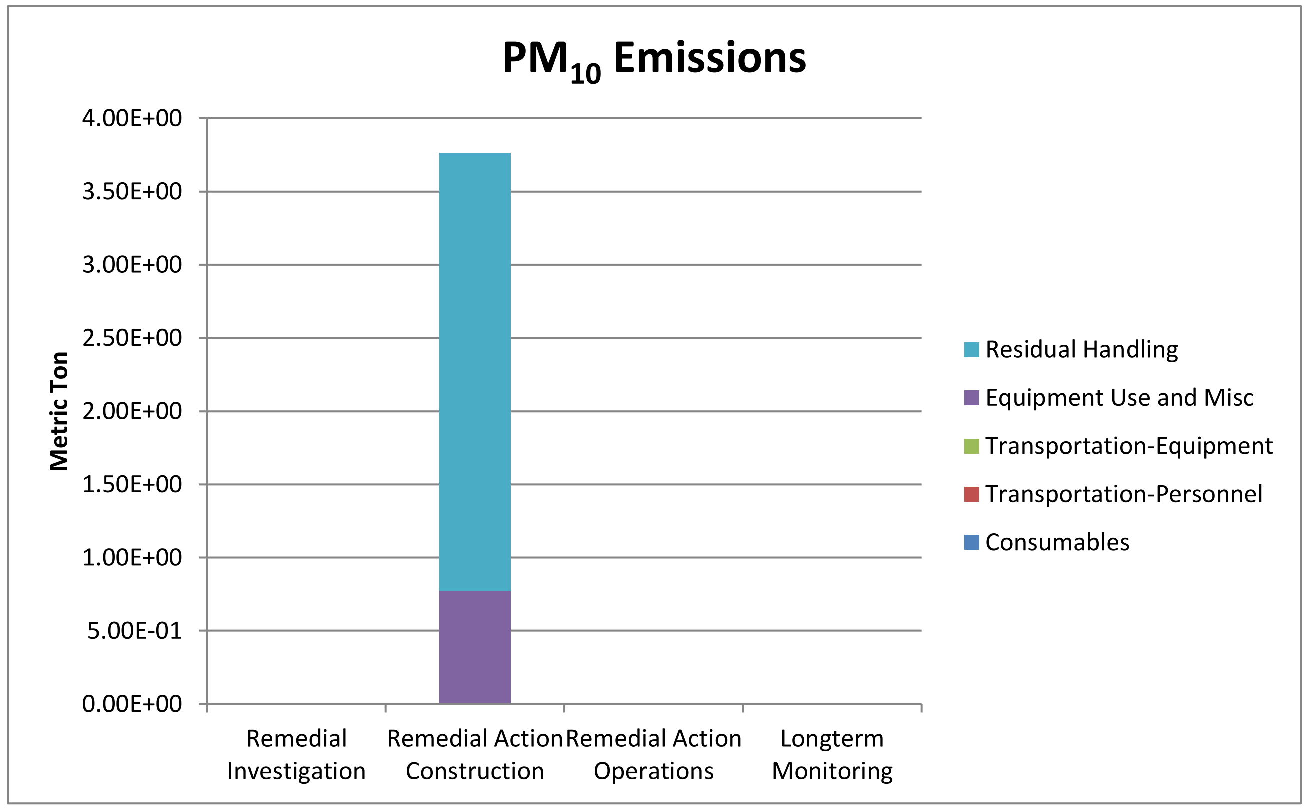

GHG Emissions
Metric Tons
4500.00
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

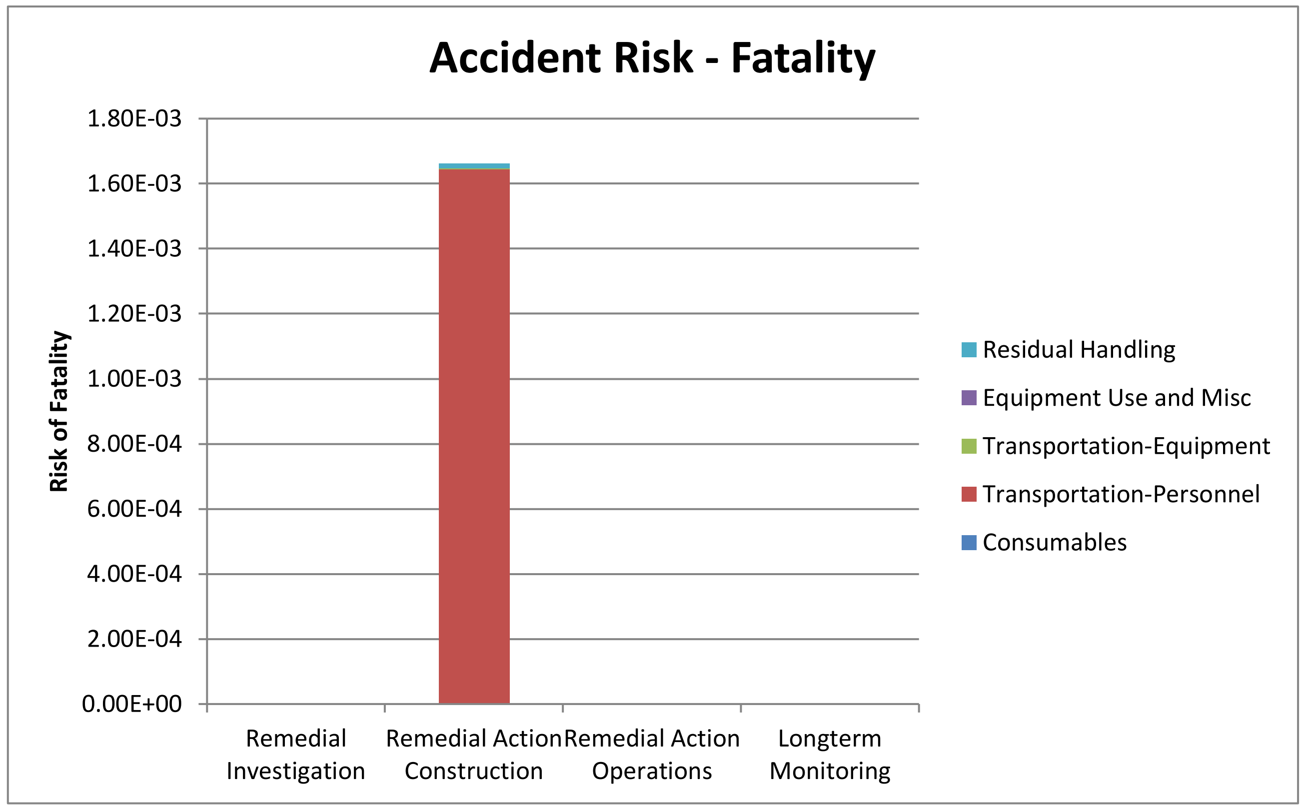

Total Energy Used
MMBTU
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

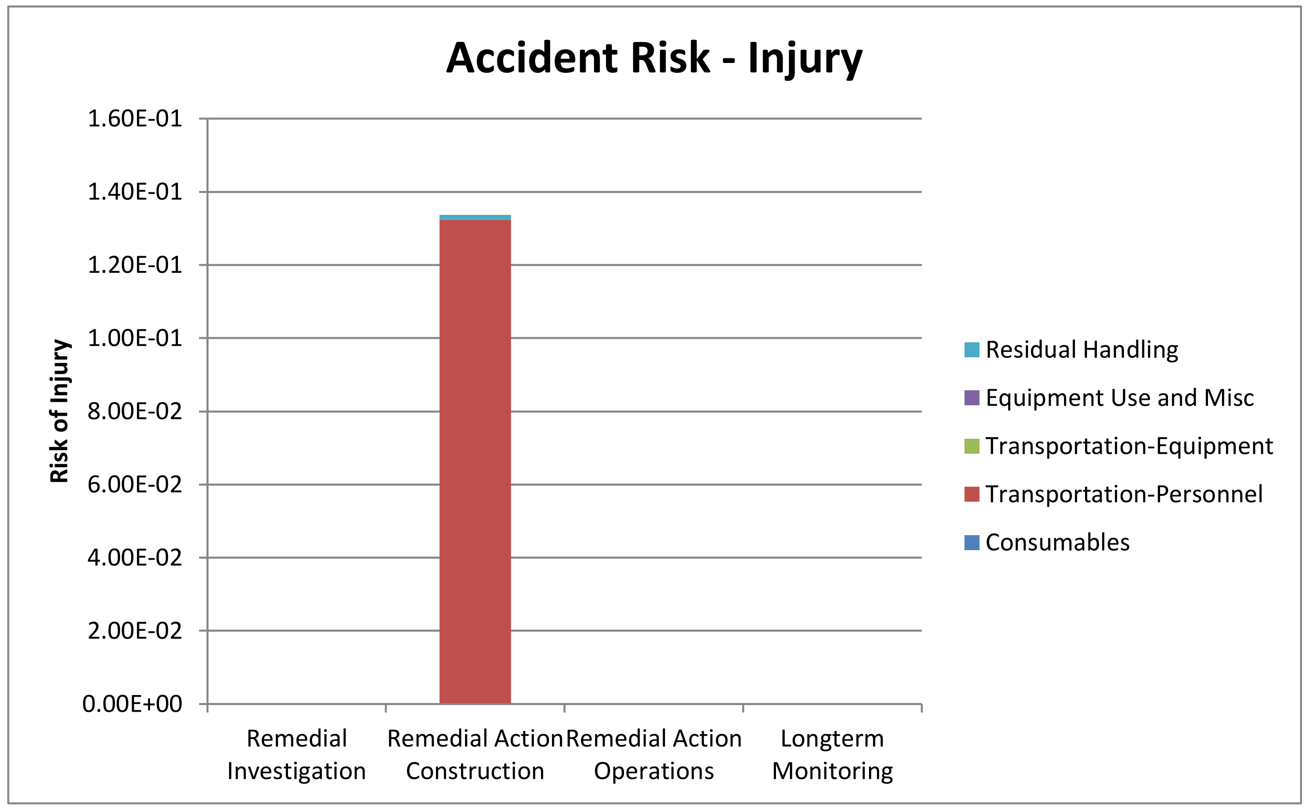

Water Consumption
Gallons
4.00E+06
3.50E+06
3.00E+06
2.50E+06
2.00E+06
1.50E+06
1.00E+06
5.00E+05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
1.00E+01
9.00E+00
8.00E+00
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
4.50E+00
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
1.80E-03
1.60E-03
1.40E-03
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

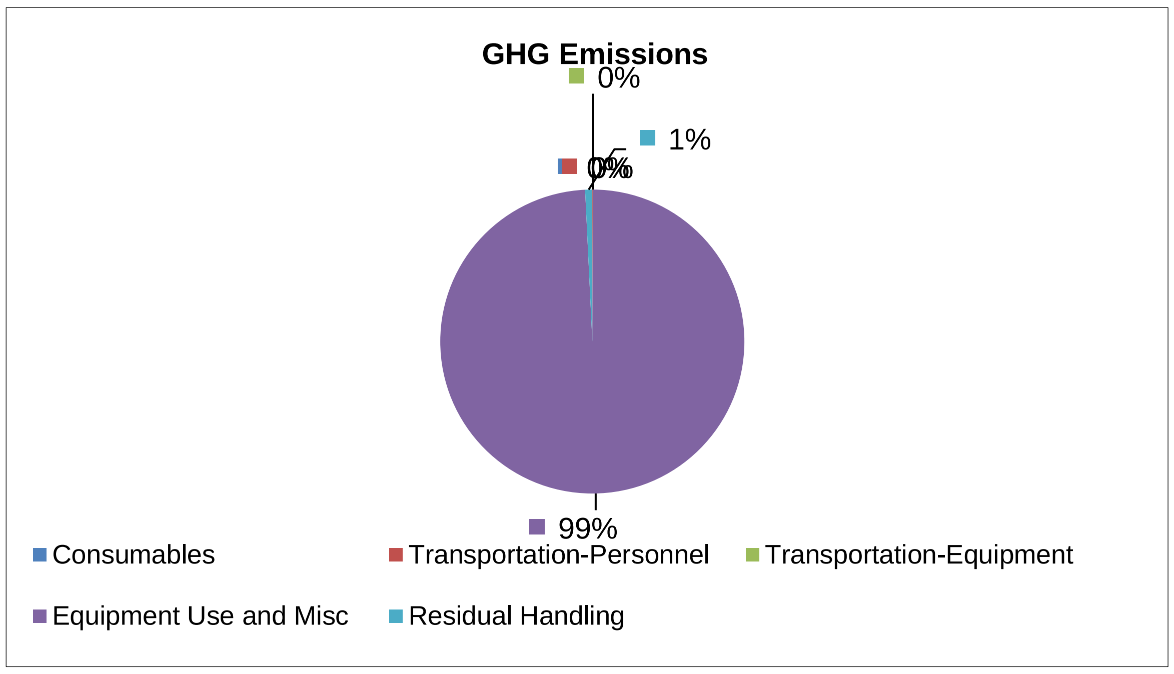

Accident Risk - Injury
Risk of Injury
1.60E-01
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

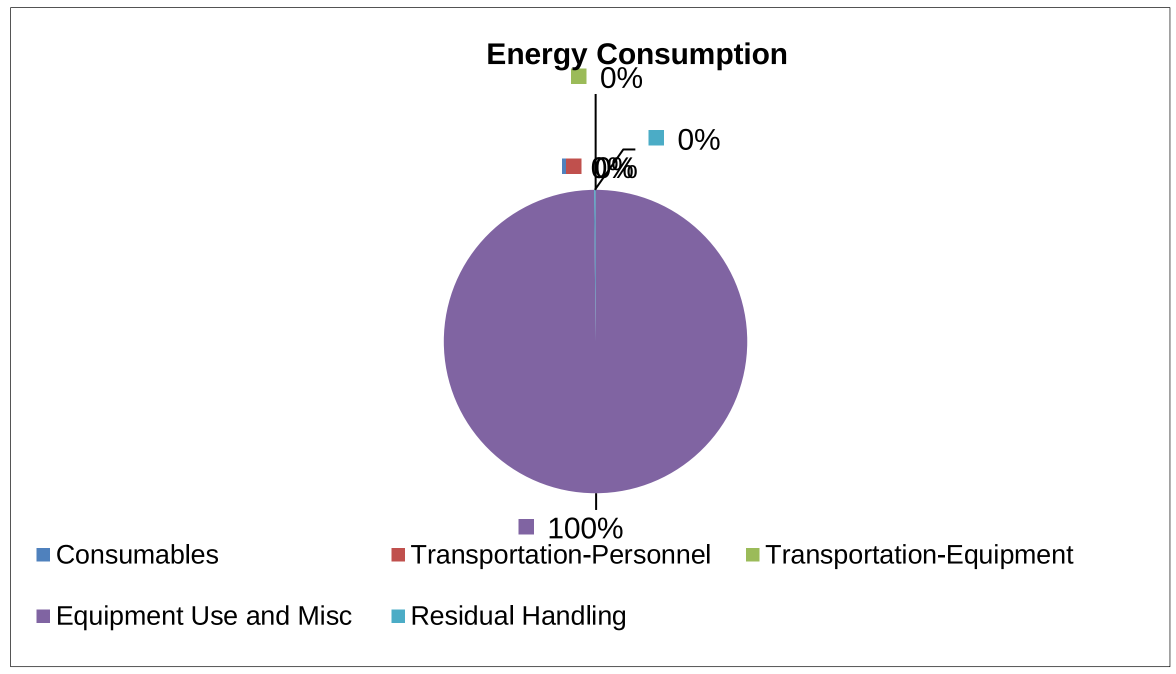
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	**Materials**								Tonnes				MWhr	gal x 1000
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	High Visibility - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	139.75	lbs	0.31	0.16	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	Sheet Piling	Steel	NZ Hot Rolled Steel Pile, 24.04 lb/ft2	129,740,292.00	lbs	165326.20	158865.66	17.65	47.07	0.35	135.33	0.00	2737025.53	116590.10
RAC	Clean Fill	Soil	assume top soil	36,324,000.00	lbs	378.89	378.89	0.00	0.00	0.00	0.00	0.00	10012.60	0.00
RAC	Top Soil	Soil	assume top soil	10,508,000.00	lbs	109.61	109.61	0.00	0.00	0.00	0.00	0.00	2896.50	0.00
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,021.00	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.89	1.82
RAC	Asphalt	Asphalt	asphalt, 3,541 tons	25,448.00	lbs	0.26	0.21	0.00	0.00	0.00	0.00	0.18	1.15	0.00
RAC	Crushed Concrete	General Concrete	crushed concrete, 4,640 tons, 145 pcf	35,100.00	lbs	2.07	2.07	0.00	0.00	0.00	0.00	0.00	20.43	0.00
	Subtotal					**165852.56**	**159377.60**	**17.69**	**47.19**	**0.35**	**135.40**	**0.19**	**2750225.89**	**116596.84**
	Construction Equipment								Tonnes				MWhr	gal x 1000
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	4 intermediate and deep wells, 80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		5,376.00	hrs	944.89	944.89	0.00	0.00	6.49	1.74	0.54	4686.63	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		10,752.00	hrs	218.17	218.17	0.00	0.00	2.00	0.41	0.25	919.81	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	5,376.00	hrs	322.37	322.37	0.00	0.00	2.14	0.59	0.22	1730.11	
	Subtotal					**1508.93**	**1508.86**	**0.00**	**0.00**	**10.82**	**2.74**	**1.05**	**7450.17**	**0**
	Operating Consumption						Tonnes						MWhr	gal x 1000
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**167,361**	**160,886**	**17.69**	**47.19**	**11.17**	**138.14**	**1.24**	**2,757,676**	**116,597**

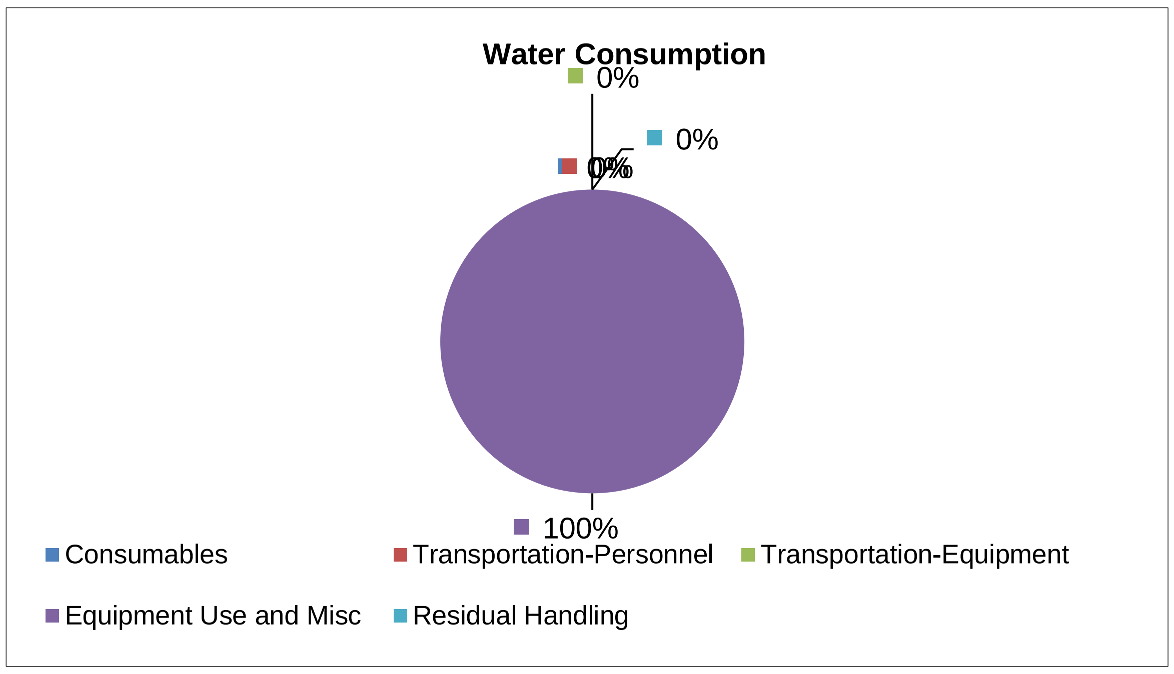
Alternative 1
Values Input into SiteWise as "Other"

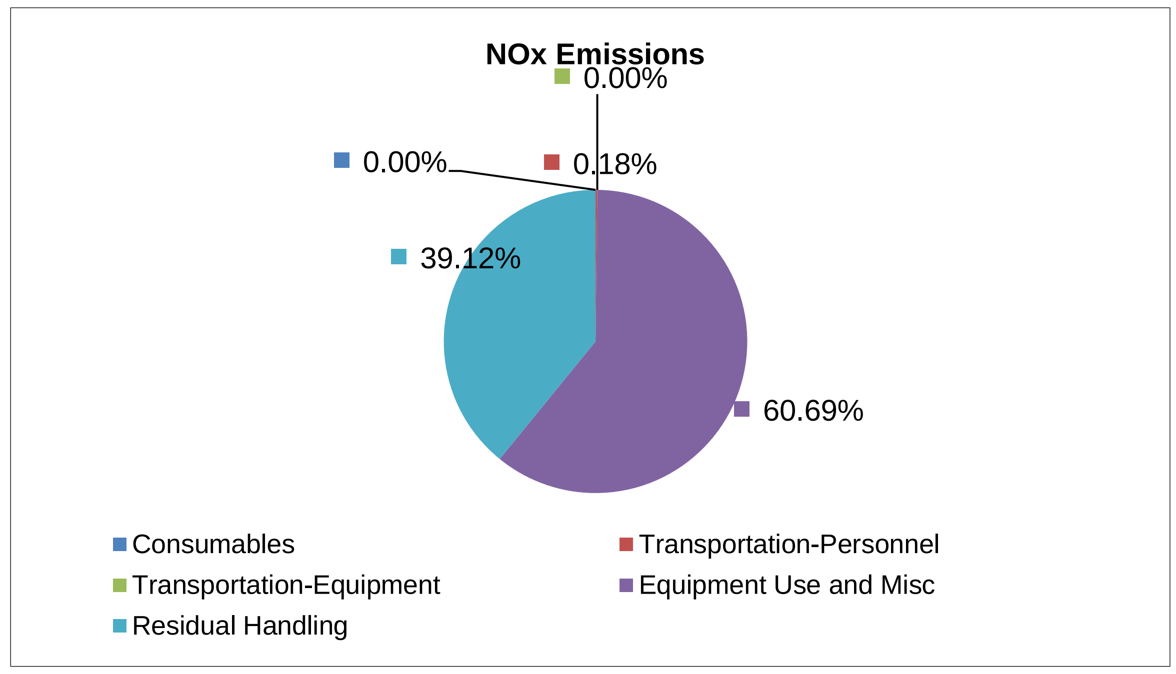
Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	167,361.49	160,886.46	5,483.99	991.04	11.17	138.14	1.24	9,409,190.71	116,596,841.31
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

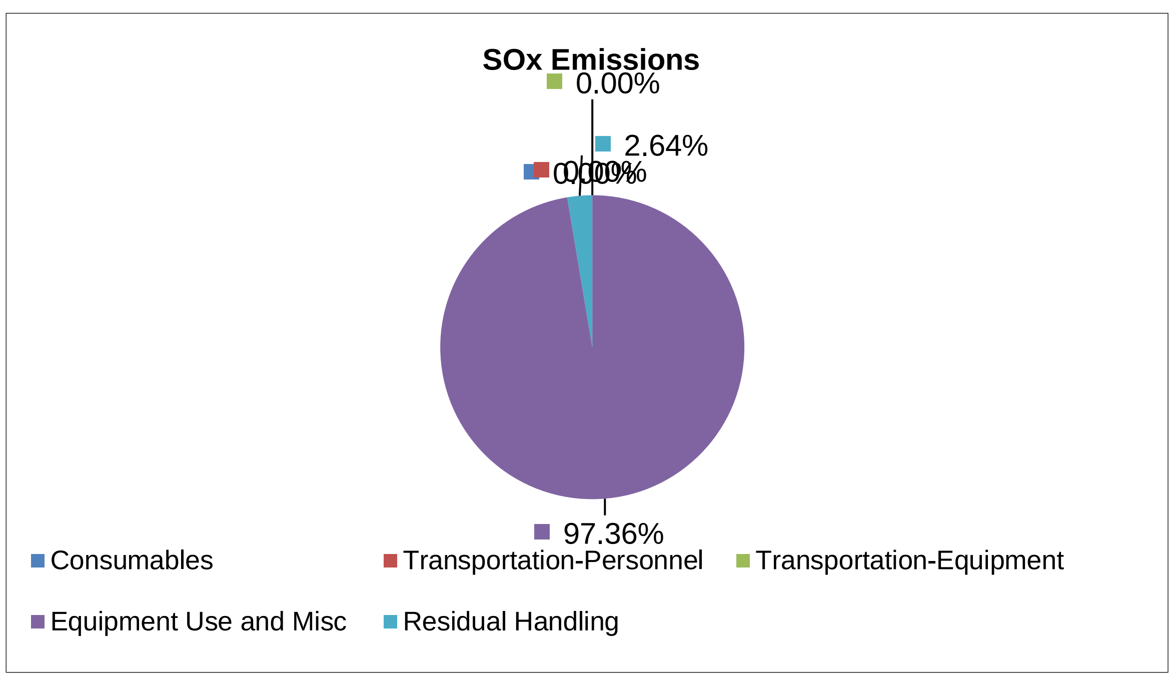
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

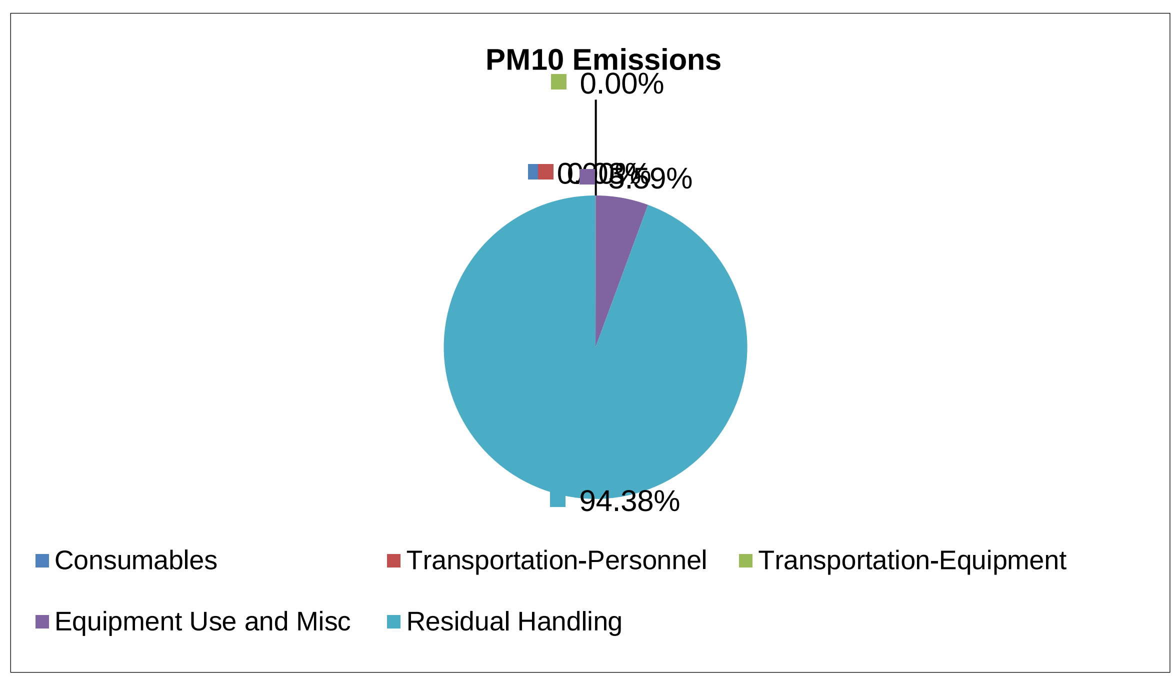

GHG Emissions
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

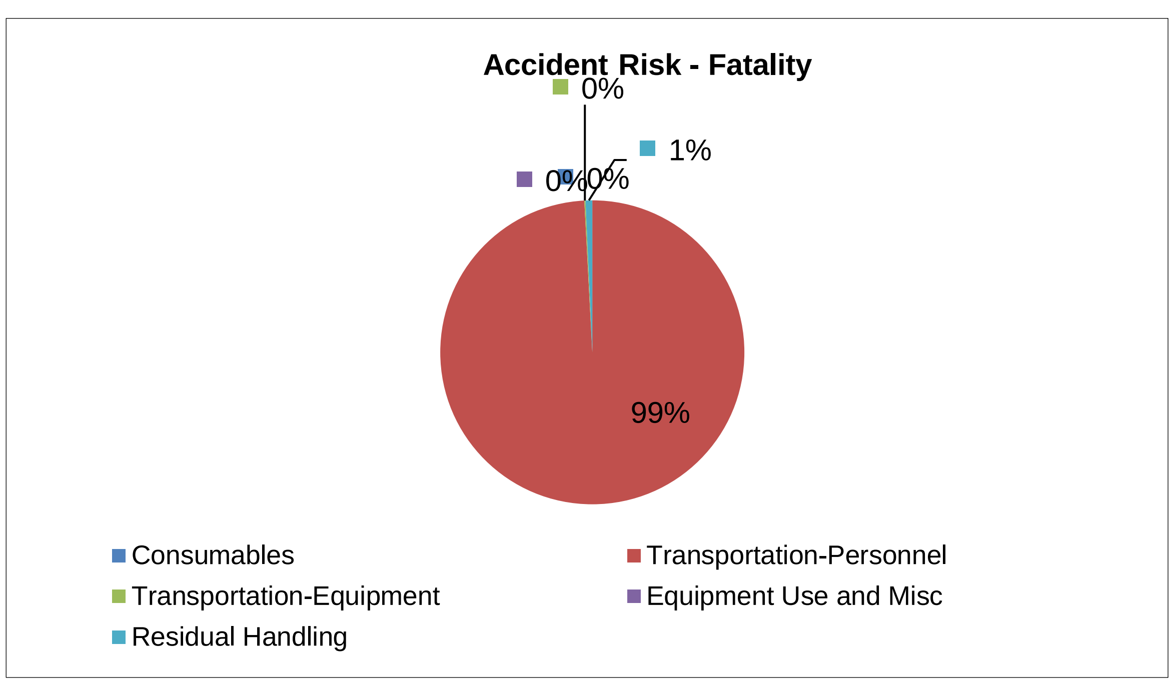

Energy Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

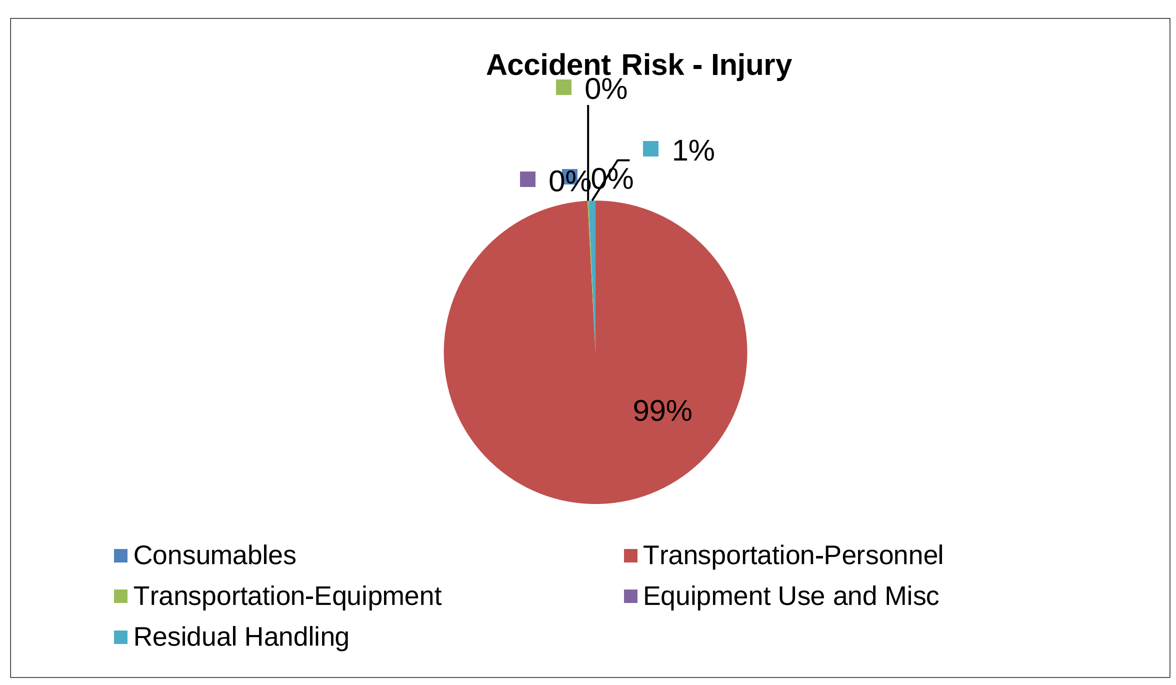

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.00%
0.18%
39.12%
60.69%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
2.64%
97.36%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
94.38%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

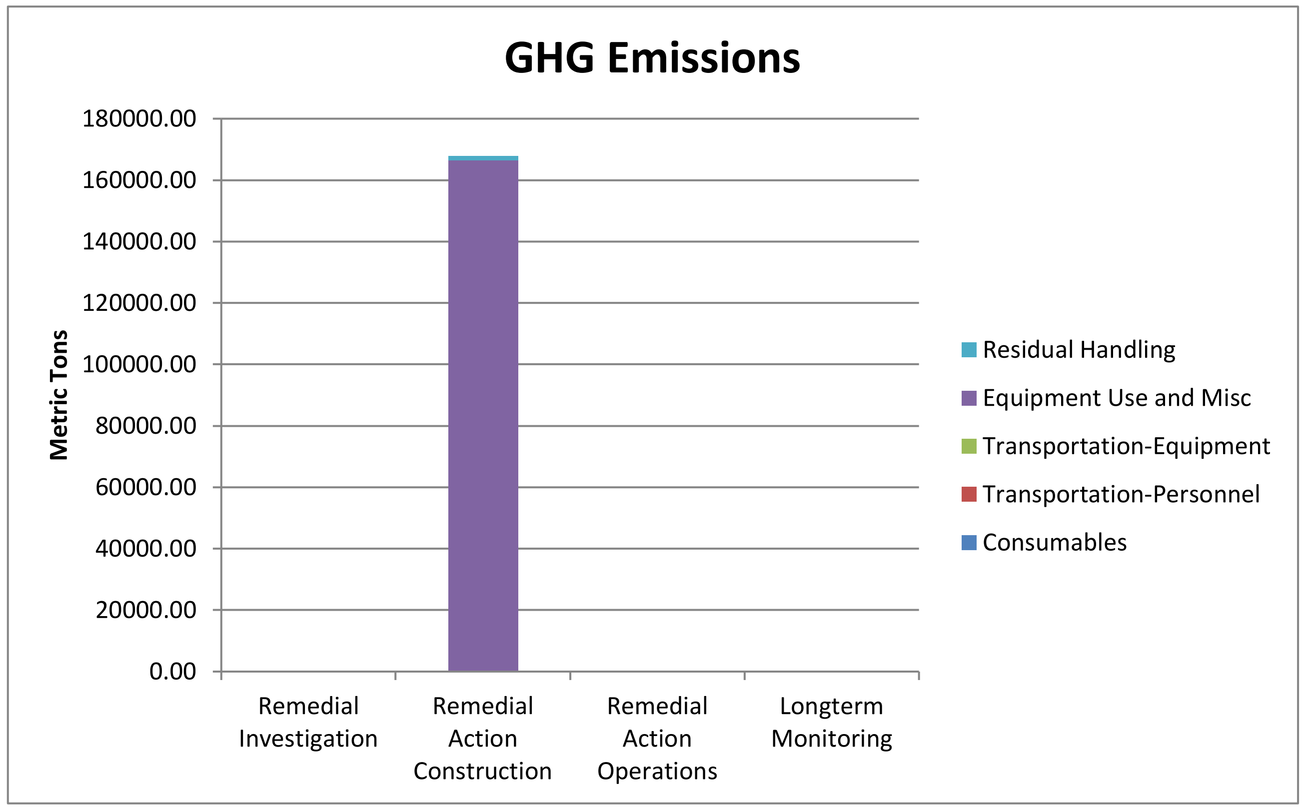

Accident Risk - Injury
0%
1%
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

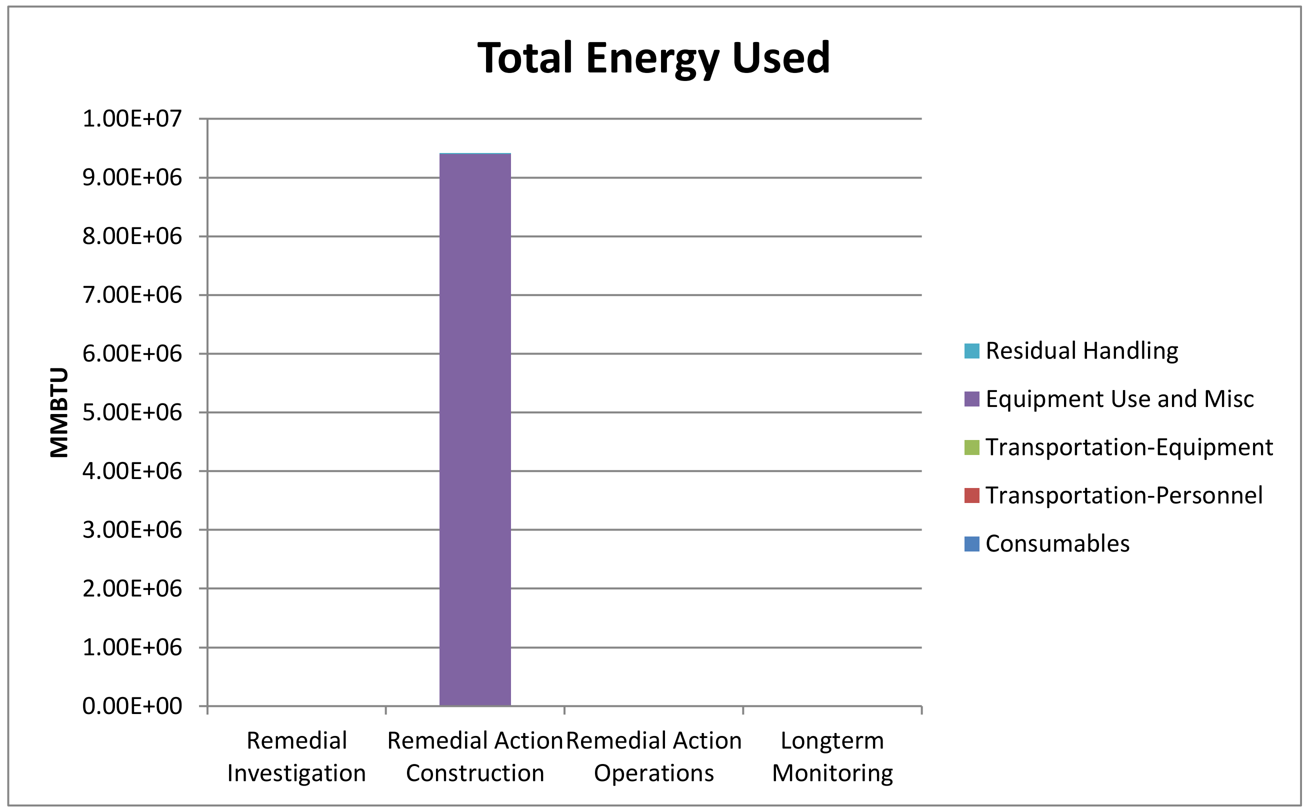
Sustainable Remediation - Environmental Footprint Summary

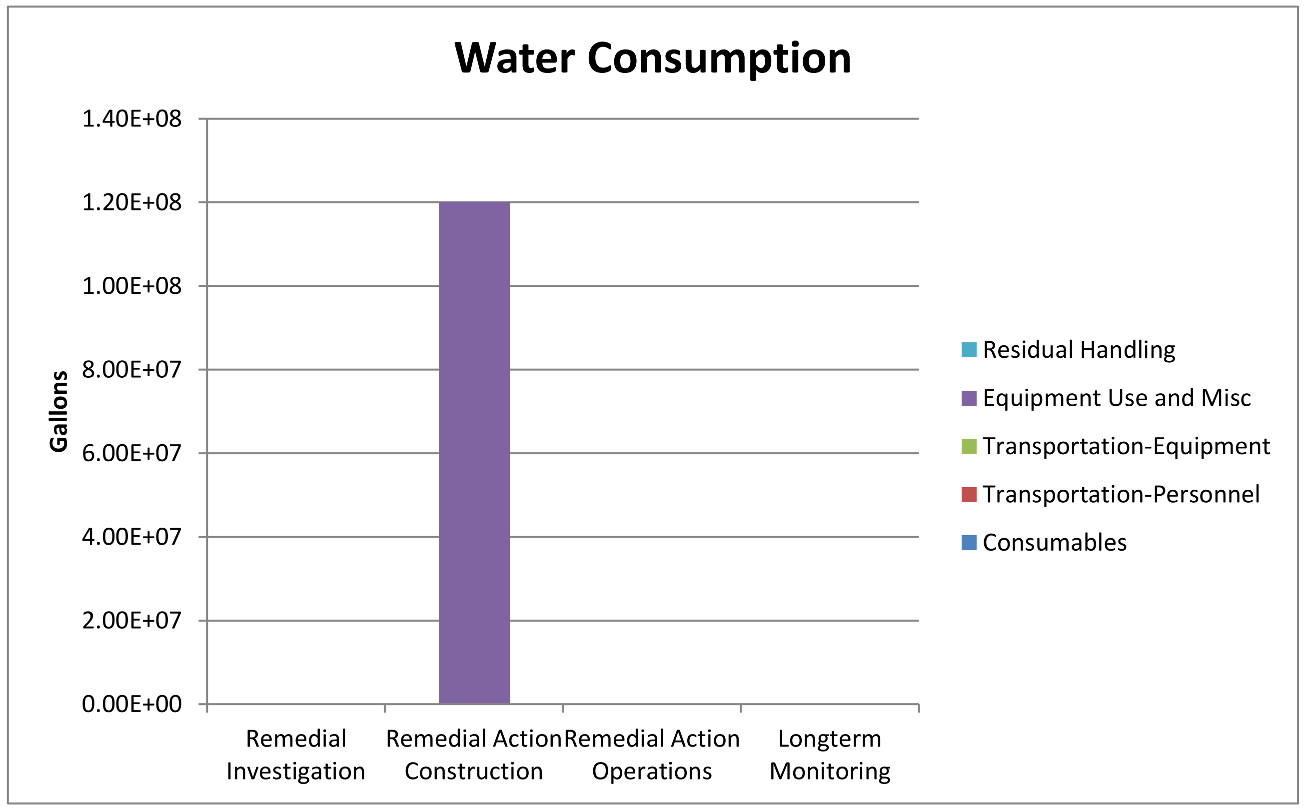
Phase	Activities	GHG Emissions metric ton	Total energy Used MMBTU	Water Consumption gallons	NOx emissions metric ton	SOx Emissions metric ton	PM10 Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	89.62	1.1E+03	NA	3.3E-02	1.2E-03	6.7E-03	1.8E-03	1.5E-01
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	166,490.03	9.4E+06	1.2E+08	1.1E+01	1.4E+02	1.2E+00	0.0E+00	0.0E+00
	Residual Handling	1,270.96	1.3E+04	NA	7.1E+00	3.8E+00	2.0E+01	1.3E-05	1.1E-03
	Sub-Total	167,851.53	9.41E+06	1.20E+08	1.81E+01	1.44E+02	2.15E+01	1.85E-03	1.49E-01
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**1.7E+05**	**9.4E+06**	**1.2E+08**	**1.8E+01**	**1.4E+02**	**2.1E+01**	**1.8E-03**	**1.5E-01**

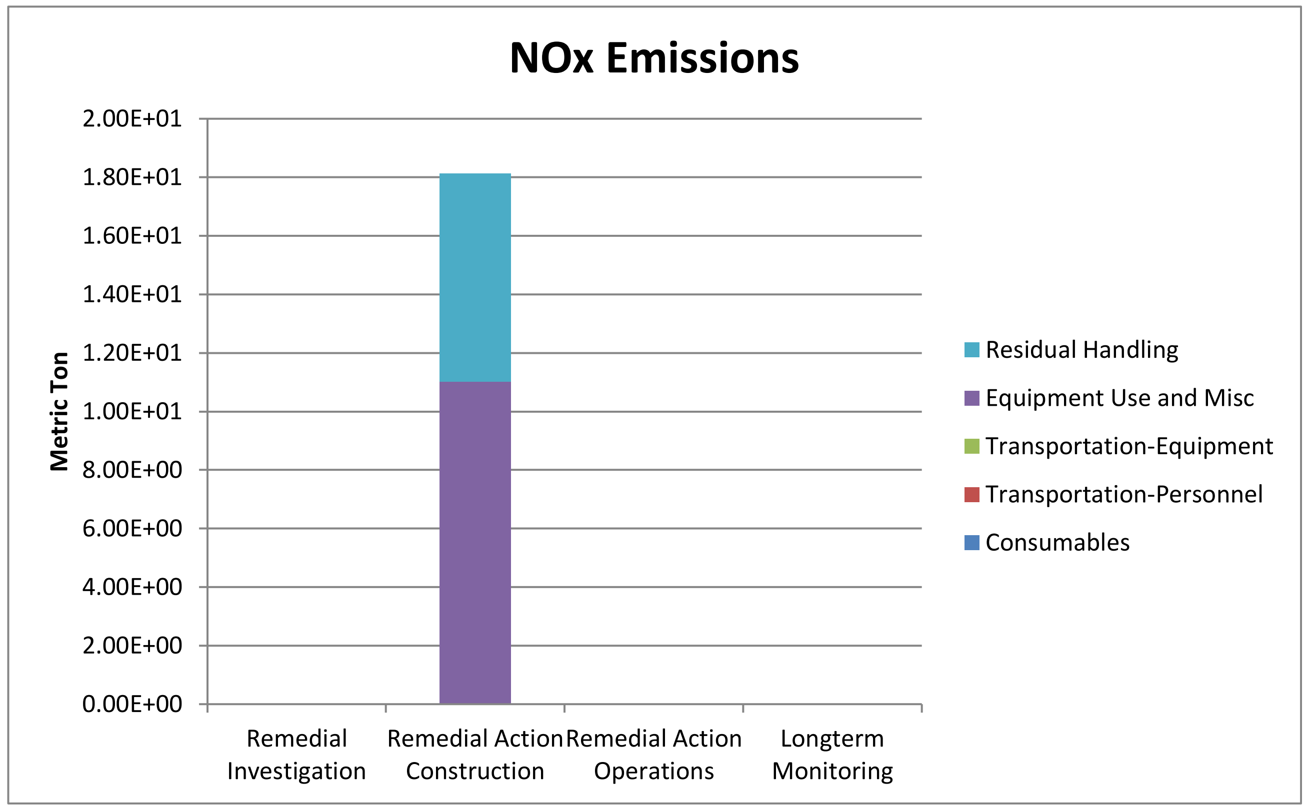
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space tons	Hazardous Waste Landfill Space tons	Topsoil Consumption cubic yards	Costing $	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	8.8E+04	2.2E+04	0.0E+00	0	1.2E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**8.8E+04**	**2.2E+04**	**0.0E+00**	**$0**	**1.2E+00**

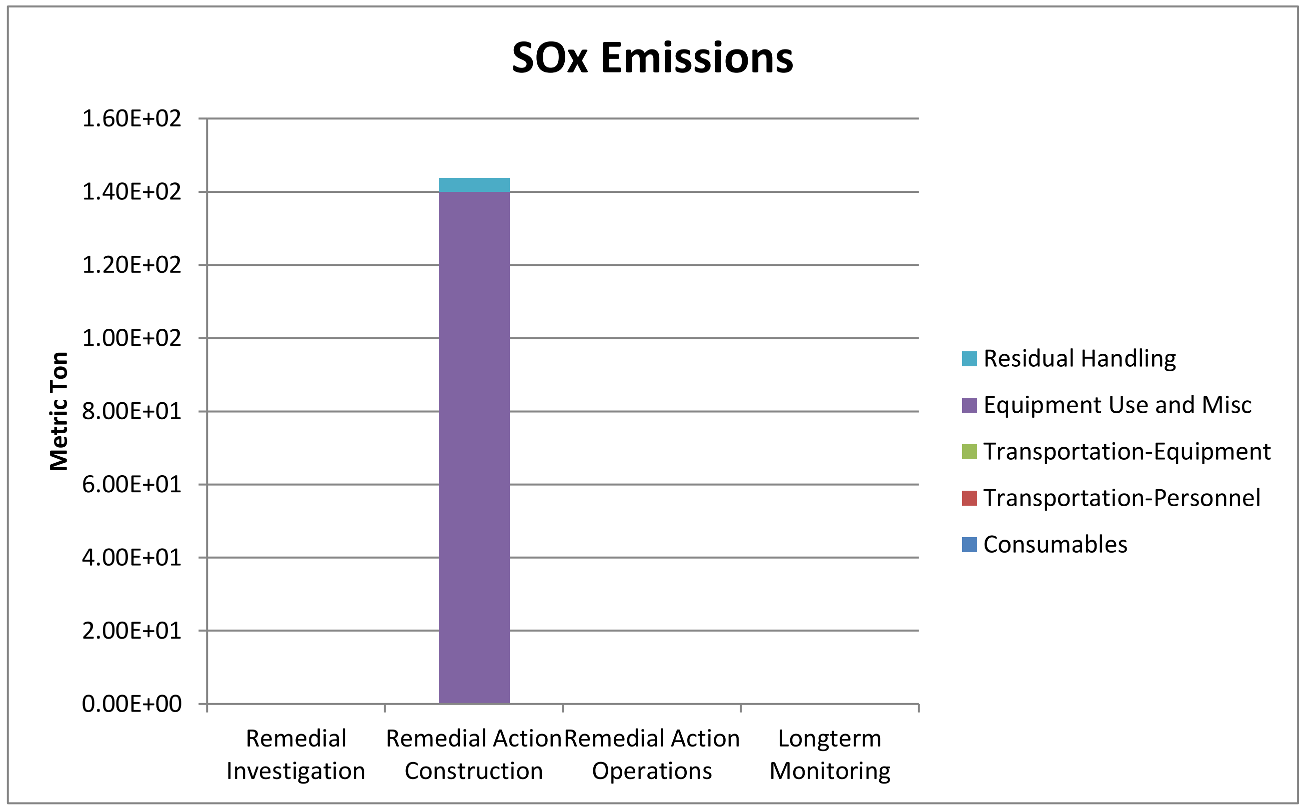
Total Cost with Footprint Reduction
$0

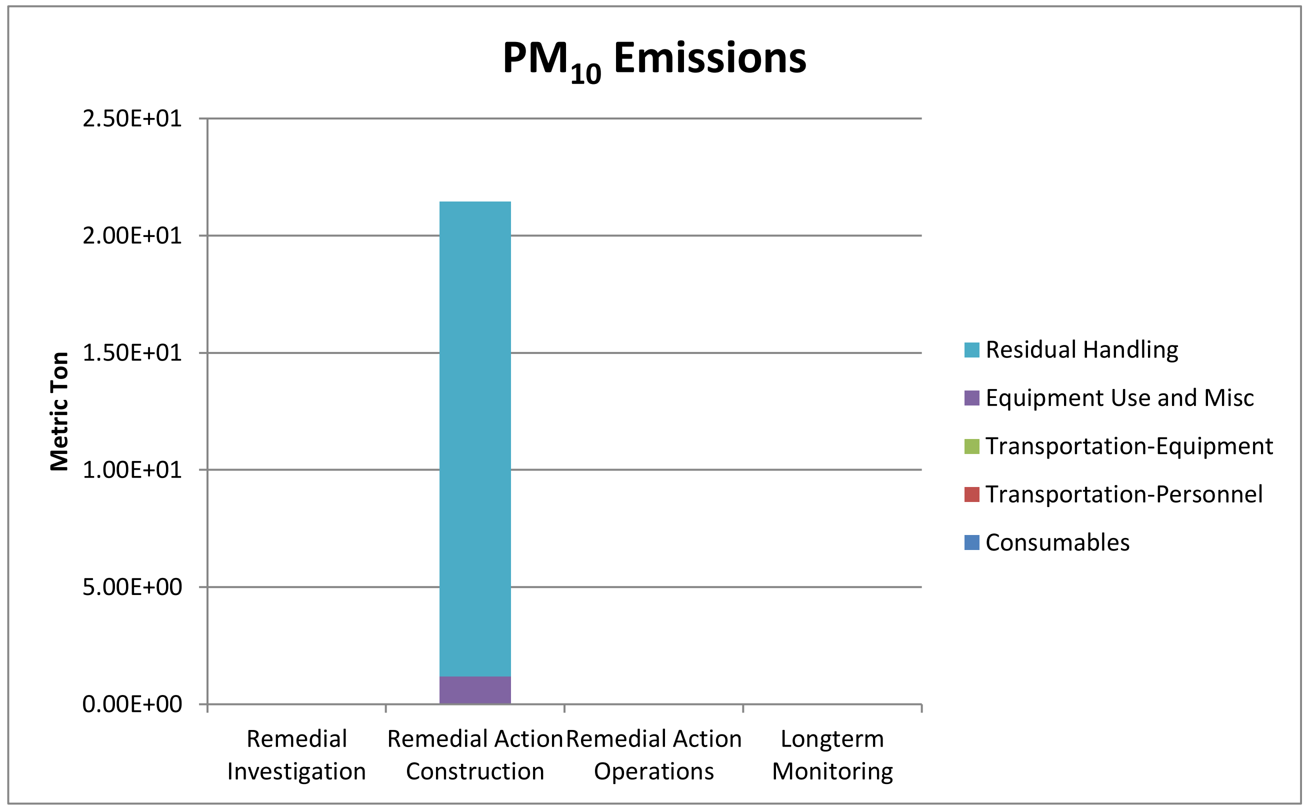

GHG Emissions
Metric Tons
180000.00
160000.00
140000.00
120000.00
100000.00
80000.00
60000.00
40000.00
20000.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

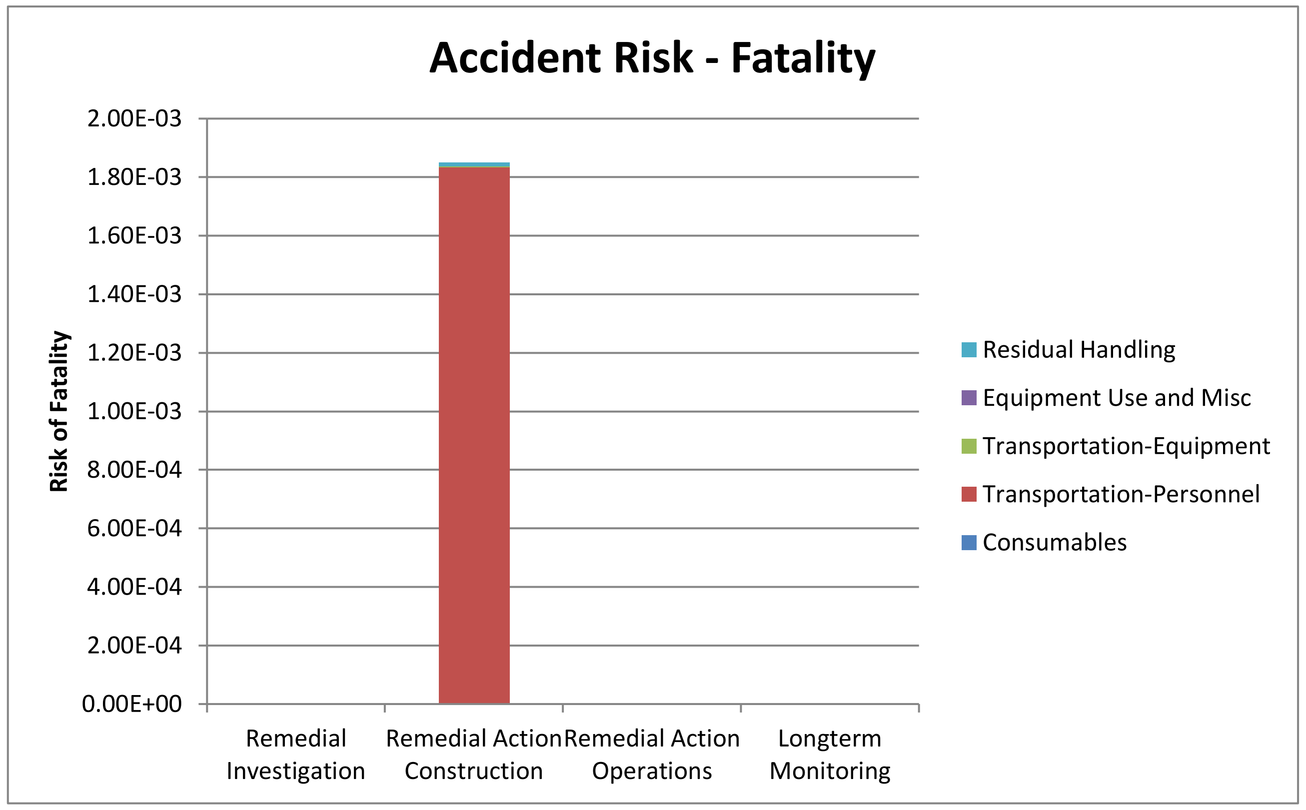

Total Energy Used
MMBTU
1.00E+07
9.00E+06
8.00E+06
7.00E+06
6.00E+06
5.00E+06
4.00E+06
3.00E+06
2.00E+06
1.00E+06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

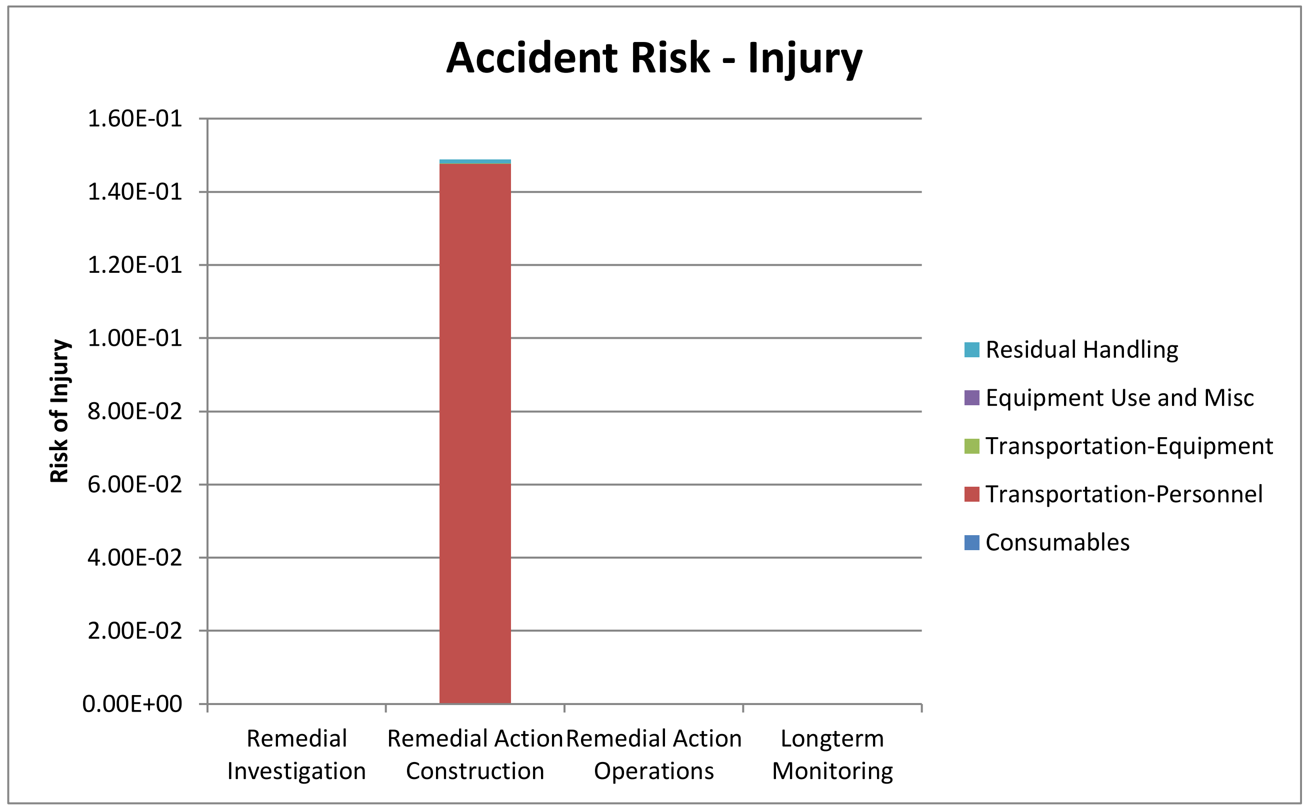

Water Consumption
Gallons
1.40E+08
1.20E+08
1.00E+08
8.00E+07
6.00E+07
4.00E+07
2.00E+07
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.00E+01
1.80E+01
1.60E+01
1.40E+01
1.20E+01
1.00E+01
8.00E+00
6.00E+00
4.00E+00
2.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.60E+02
1.40E+02
1.20E+02
1.00E+02
8.00E+01
6.00E+01
4.00E+01
2.00E+01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
2.50E+01
2.00E+01
1.50E+01
1.00E+01
5.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
2.00E-03
1.80E-03
1.60E-03
1.40E-03
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

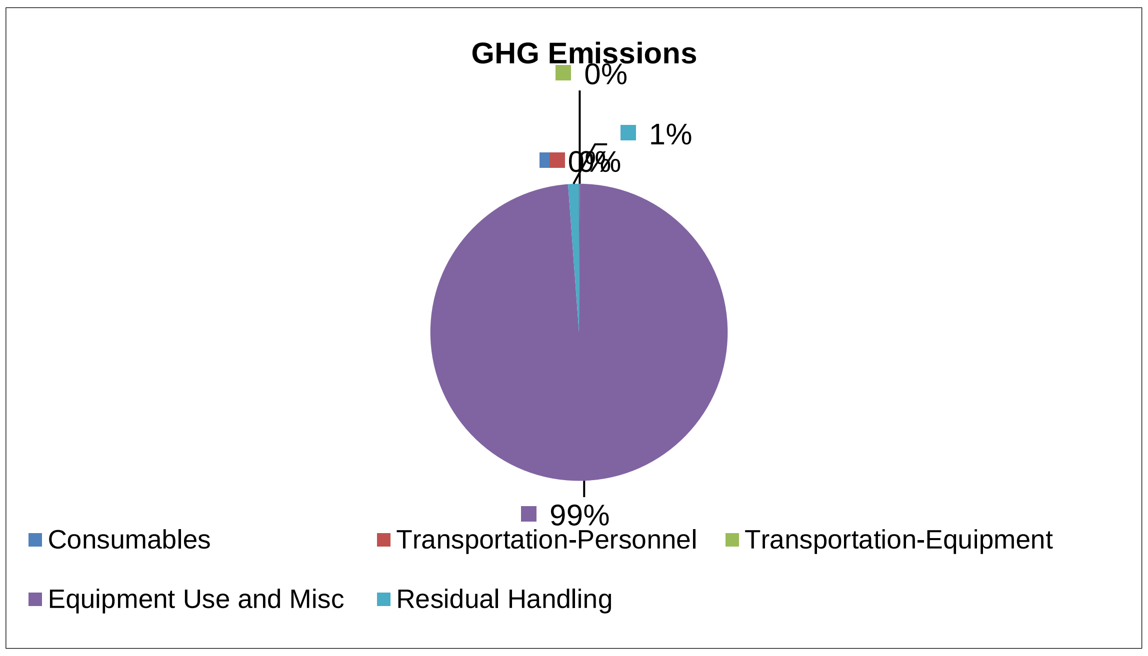

Accident Risk - Injury
Risk of Injury
1.60E-01
1.40E-01
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

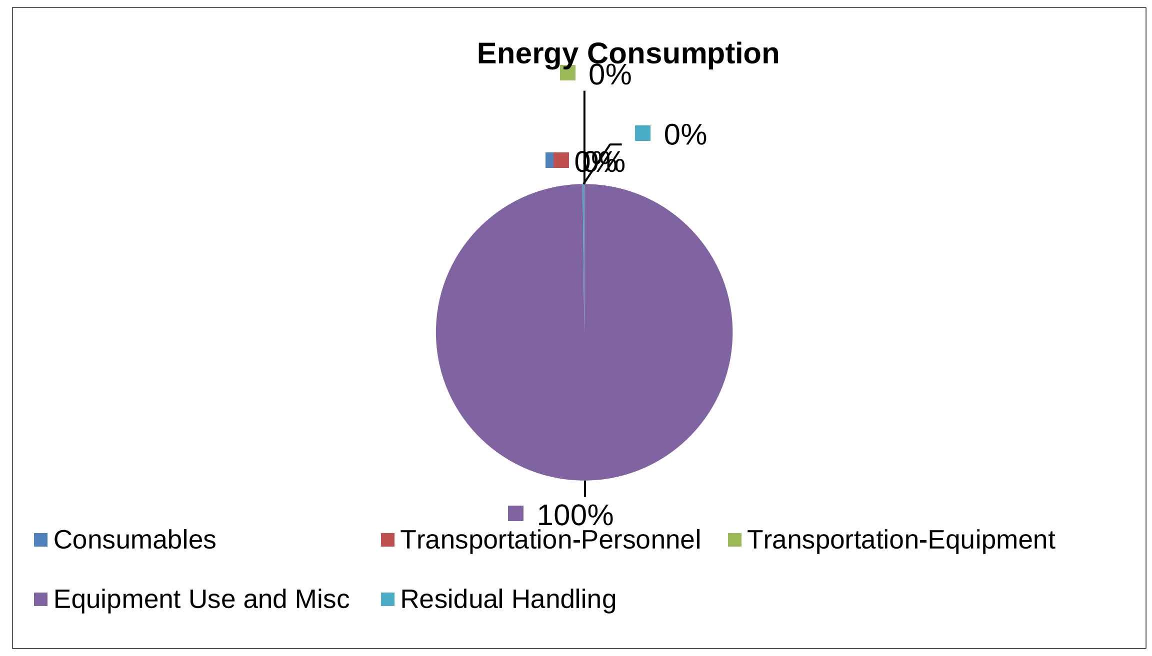
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	Materials								Tonnes				MWhr	gal x 1000
RAC	Soil Staging Pad Liner	HDPE	assume HDPE, Assume 160ftx120ft, 3 mm thick, 0.95 g/cm3	11,207.54	lbs	25.01	13.22	0.03	0.10	0.00	0.06	0.01	146.67	4.03
RAC	Soil Staging Pad Frame	Wood	Assume wood, 4x4 in, (160ftx120ft pad) 560 ft of timber, density for pine 530 kg/m3	2,058.73	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Soil Staging Pad Liner - bottom	HDPE	Assume HDPE, 10 oz/sy, 16 oz./lb, 160 ft X 120ft	1,320.00	lbs	2.95	1.56	0.00	0.01	0.00	0.01	0.00	17.27	0.47
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAC	Silt Fencing - Stakes	Wood	stakes, balsa wood (170 kg/m3)	454.36	lbs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Silt Fencing - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	262.50	lbs	0.59	0.31	0.00	0.00	0.00	0.00	0.00	3.44	0.09
RAC	High Visibility - Geotextile	HDPE	geotextile, use HDPE, 6 oz/sy	139.75	lbs	0.31	0.16	0.00	0.00	0.00	0.00	0.00	1.83	0.05
RAC	Sheet Piling	Steel	NZ Hot Rolled Steel Pile, 24.04 lb/ft2, 2.5 acre	155,623,356.00	lbs	198308.62	190559.21	21.17	56.46	0.42	162.33	0.00	3283059.51	139849.71
RAC	Clean Fill	Soil	assume top soil	435,564,000.00	lbs	4543.30	4543.30	0.00	0.00	0.00	0.00	0.00	120061.93	0.00
RAC	Top Soil	Soil	assume top soil	756,000.00	lbs	7.89	7.89	0.00	0.00	0.00	0.00	0.00	208.39	0.00
RAC	Seed Fertilizer	Fertilizer	22 msf, assume fertilizer, assume 20 lb per smf	4,021.00	lbs	5.01	5.01	0.00	0.00	0.00	0.00	0.00	90.89	1.82
RAC	Asphalt	Asphalt	asphalt	25,448.00	lbs	0.26	0.21	0.00	0.00	0.00	0.00	0.18	1.15	0.00
RAC	Crushed Concrete	General Concrete	crushed concrete, 145 pcf	35,100.00	lbs	2.07	2.07	0.00	0.00	0.00	0.00	0.00	20.43	0.00
	Subtotal					**202897.66**	**195133.83**	**21.21**	**56.58**	**0.42**	**162.40**	**0.19**	**3403621.08**	**139856.45**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	4 intermediate and deep wells, 80% utilization	192.00	hrs	3.08	3.00	0.00	0.00	0.03	0.00	0.00	23.46	
RAC	Clearing/Grubbing	WOOD CHIPPER (100 hp)	1 acre RSM 2012; 31 11 10.10 0020	450.00	hrs	19.59	19.59	0.00	0.00	0.15	0.00	0.01	85.98	
RAC	Clearing/Grubbing	Chainsaw, gasoline, 3<hp<=6, 2 stroke	1 acre RSM 2012; 31 11 10.10 0021	450.00	hrs	0.85	0.85	0.00	0.00	0.00	0.00	0.01	4.18	
RAC	Excavator	Excavator, Hydraulic, 5.5 CY (diesel)		9,600.00	hrs	1687.30	1687.30	0.00	0.00	11.60	3.11	0.97	8368.99	
RAC	Front End Loader	Loader, 155 HP, 3 CY (diesel)		19,200.00	hrs	389.59	389.59	0.00	0.00	3.58	0.73	0.45	1642.51	
RAC	Dozer Crawler	Dozer, 140 HP (D6) w/A Blade (diesel)	use 140 (was 125 HP)	9,600.00	hrs	575.65	575.65	0.00	0.00	3.82	1.05	0.40	3089.49	
	Subtotal					**2676.05**	**2675.98**	**0.00**	**0.00**	**19.18**	**4.89**	**1.84**	**13214.60**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**205,574**	**197,810**	**21.21**	**56.58**	**19.60**	**167.29**	**2.04**	**3,416,836**	**139,856**

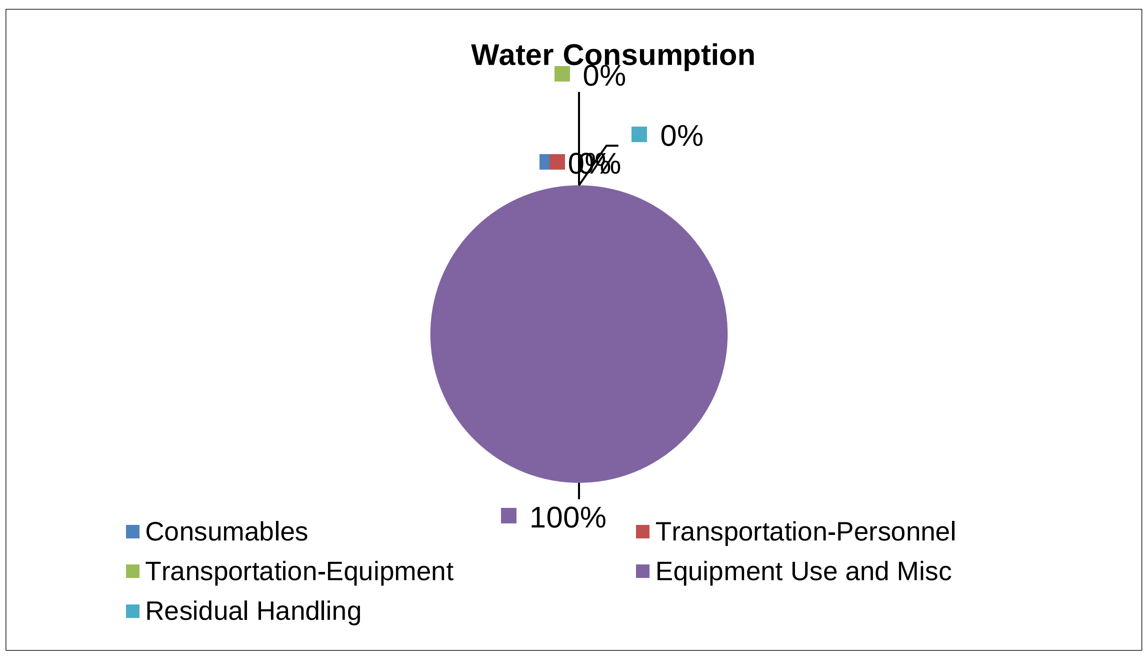
Alternative 1
Values Input into SiteWise as "Other"

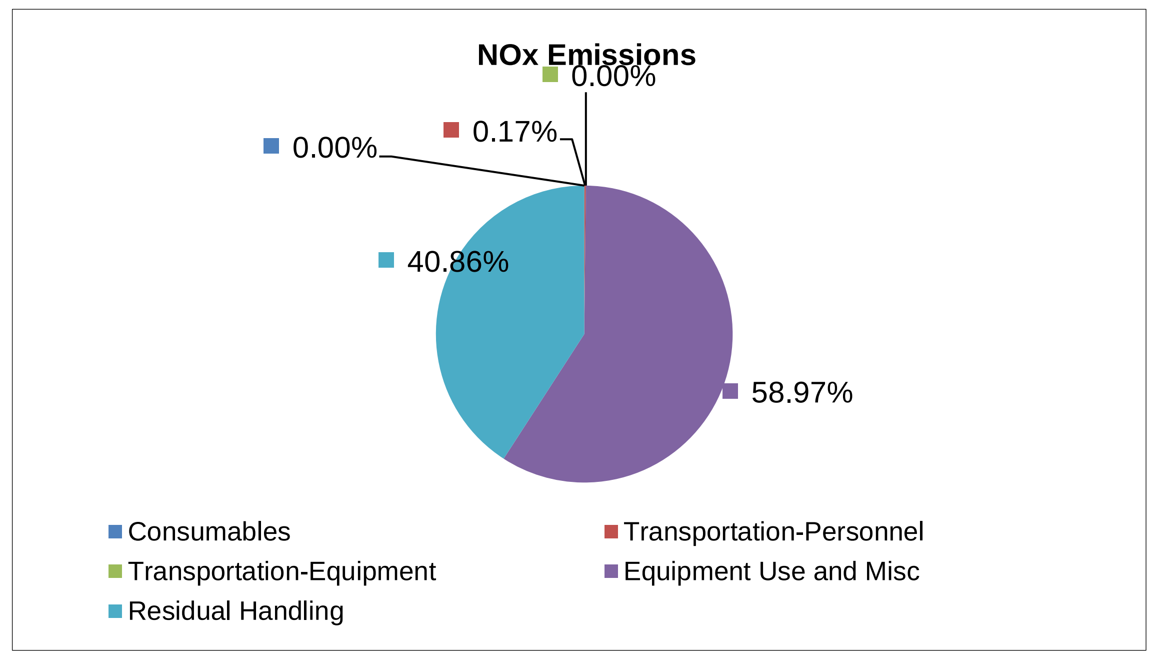
Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	205,573.72	197,809.81	6,575.66	1,188.25	19.60	167.29	2.04	11,658,243.35	139,856,453.64
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

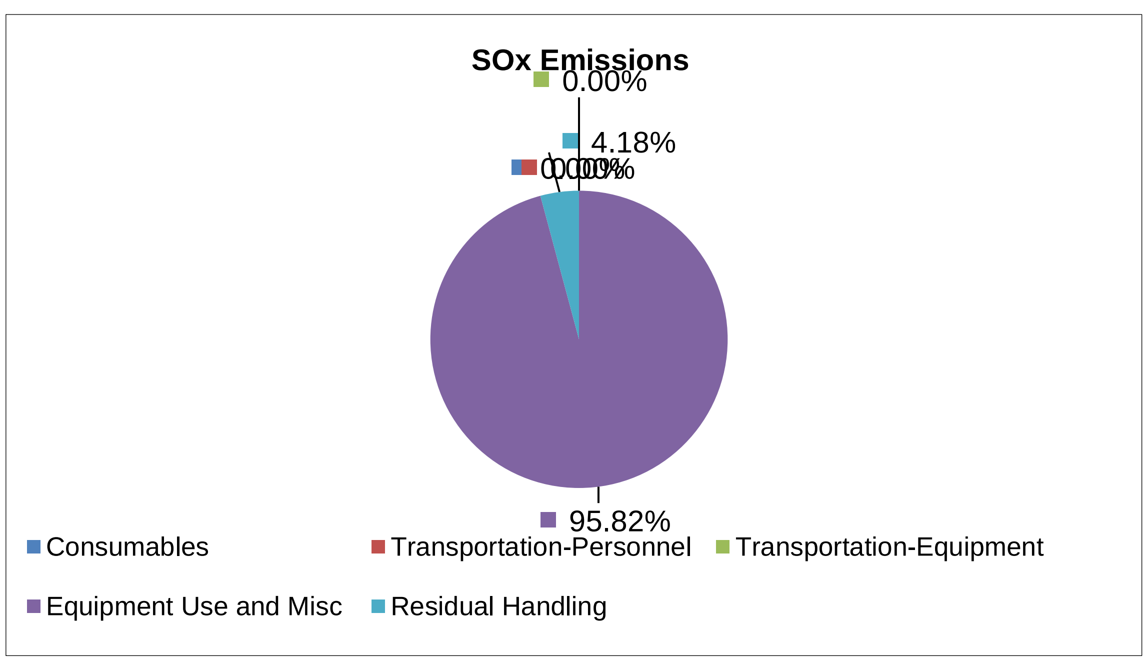
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

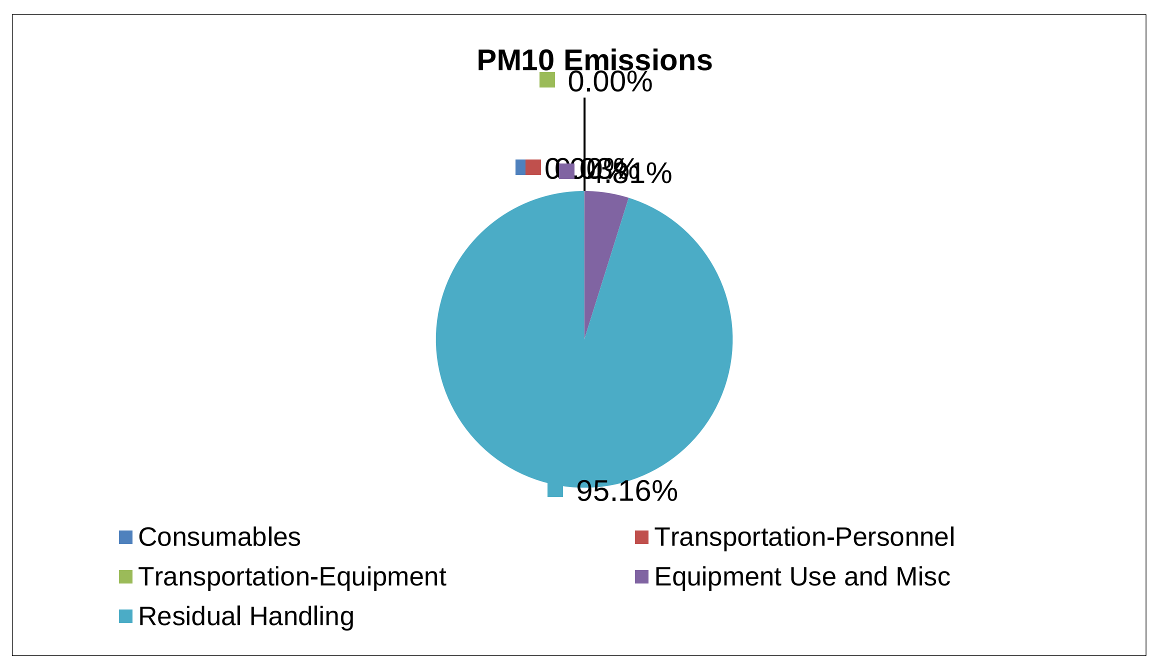

GHG Emissions
0%
1%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

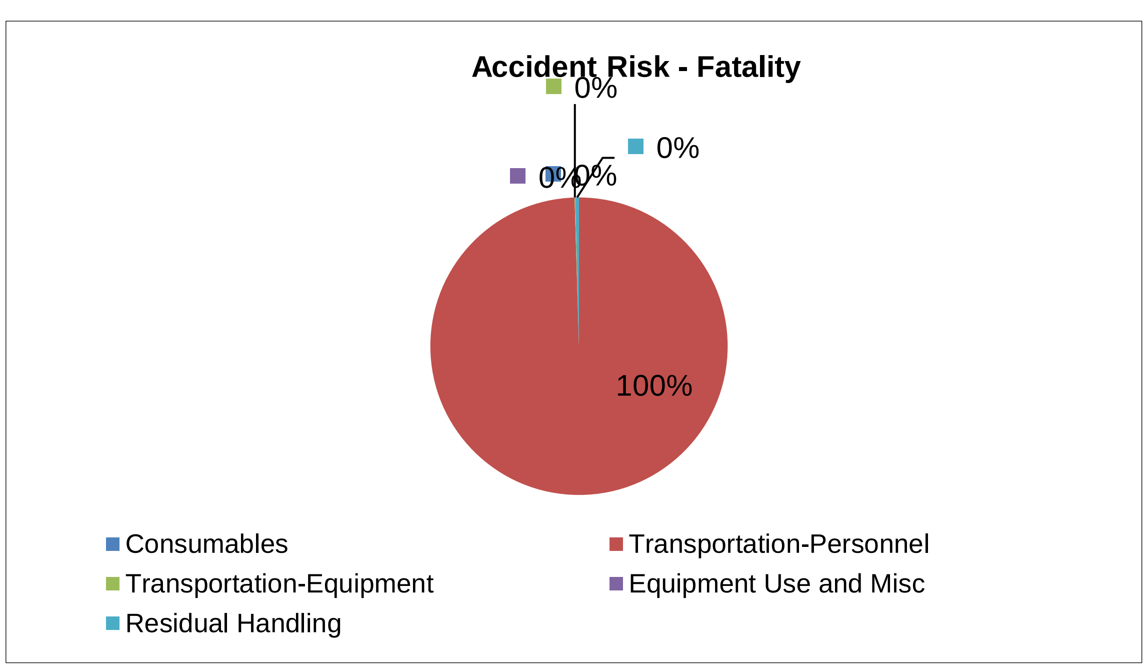

Energy Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

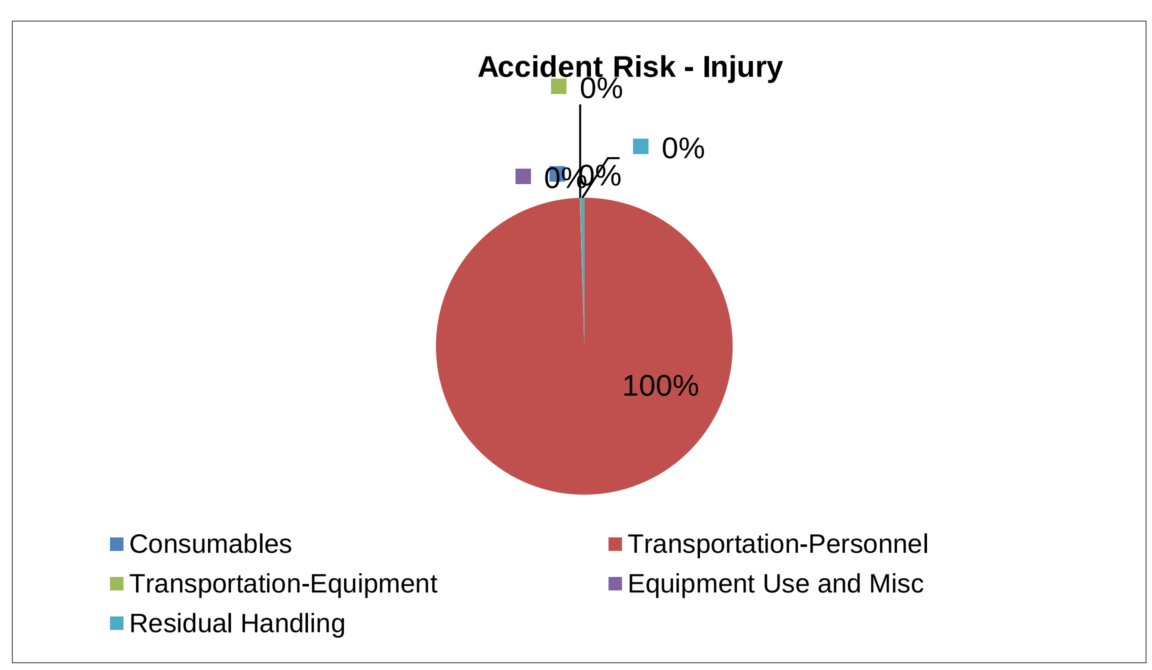

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.17%
0.00%
40.86%
58.97%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
4.18%
95.82%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
95.16%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

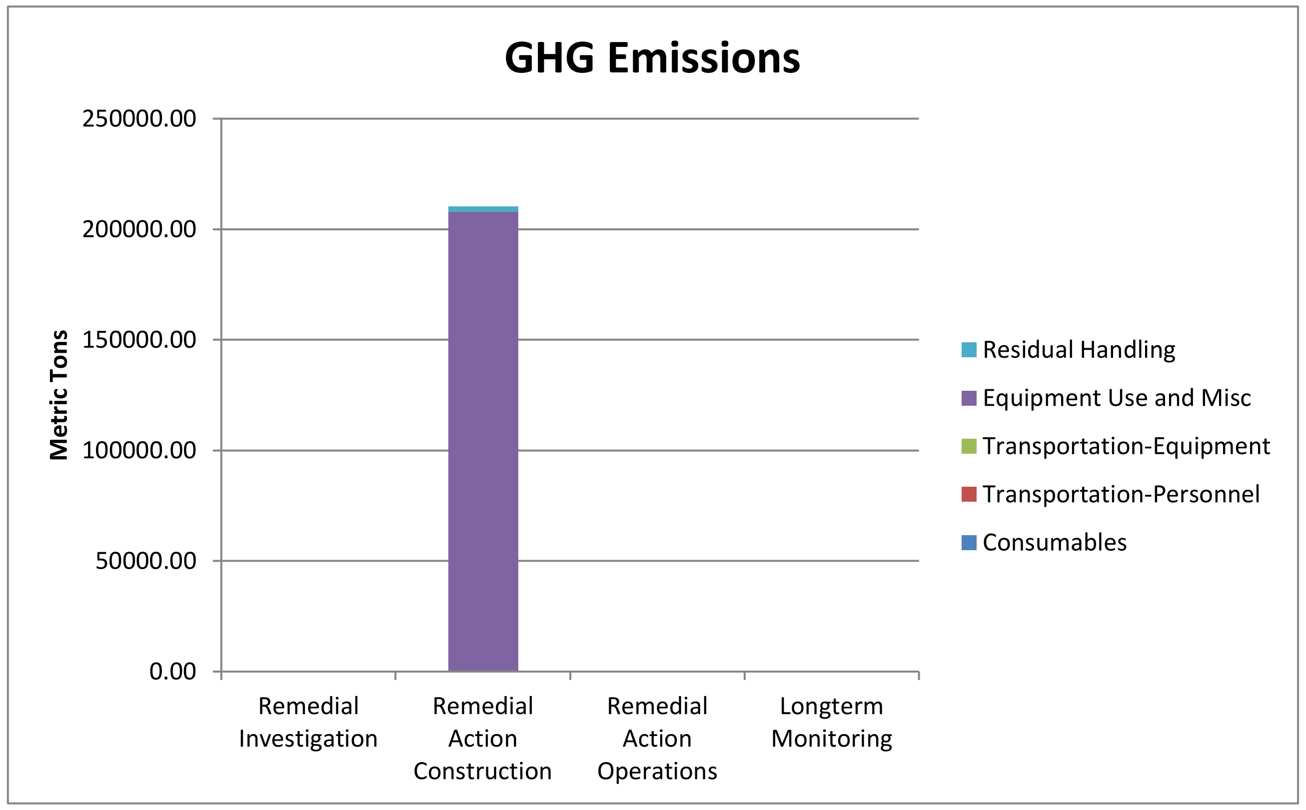

Accident Risk - Injury
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

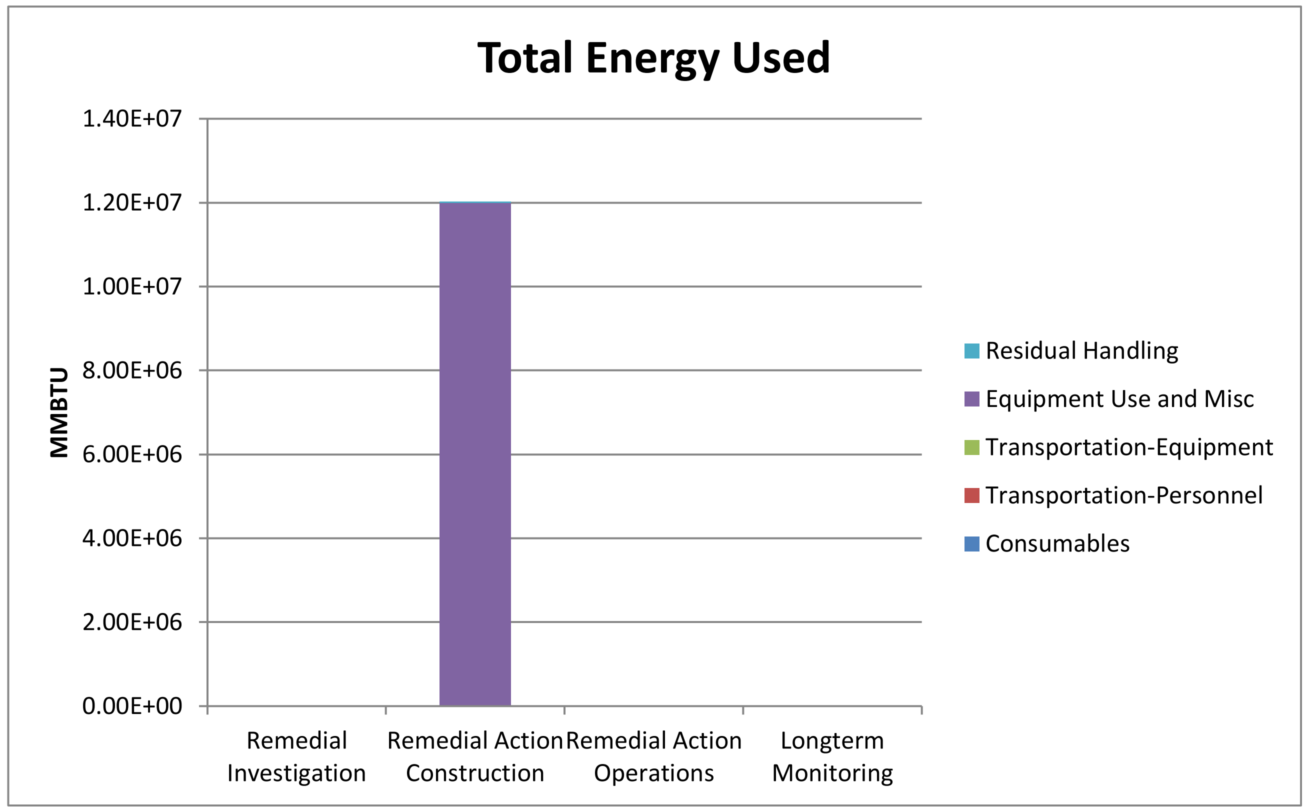
Sustainable Remediation - Environmental Footprint Summary

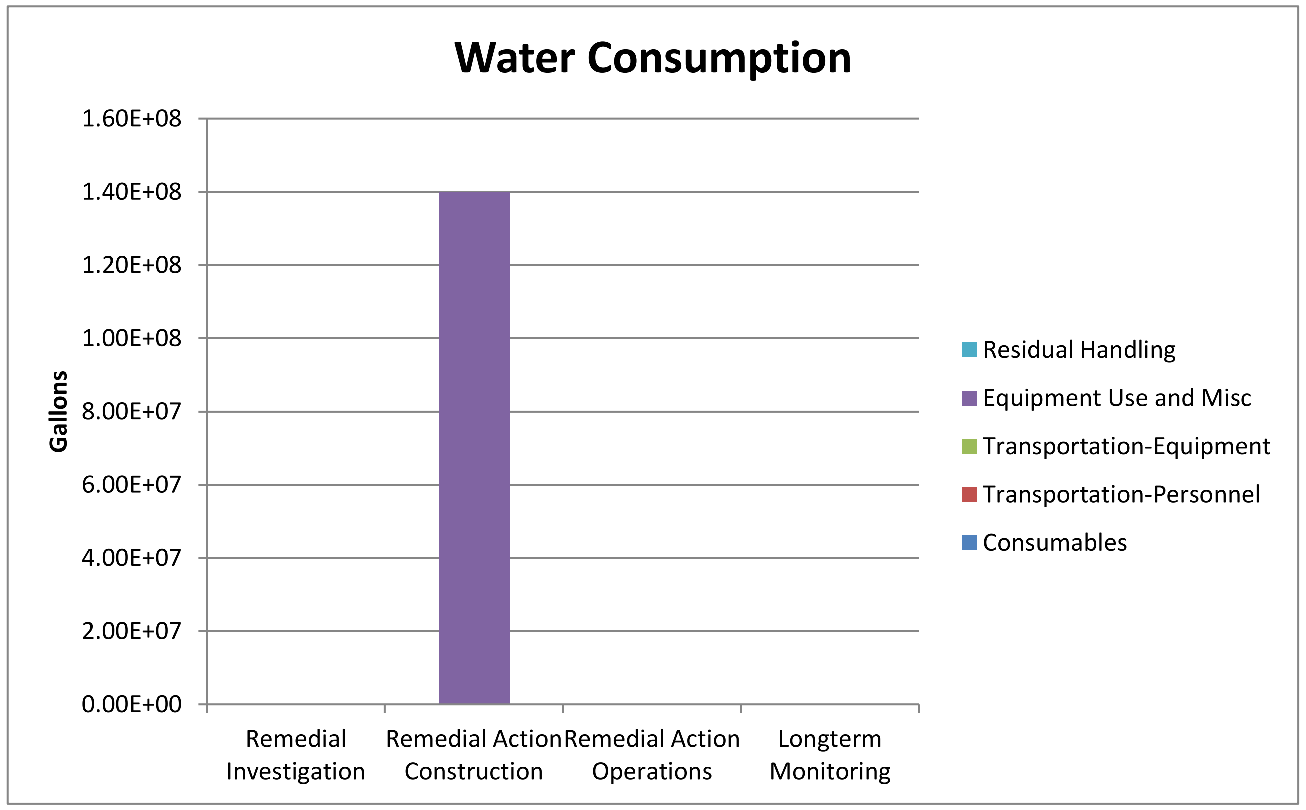
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	158.79	2.0E+03	NA	5.9E-02	2.1E-03	1.2E-02	3.2E-03	2.6E-01
	Transportation-Equipment	0.92	1.3E+01	NA	3.0E-04	1.2E-05	2.4E-05	2.3E-06	1.9E-04
	Equipment Use and Misc	207,800.03	1.2E+07	1.4E+08	2.0E+01	1.7E+02	2.0E+00	0.0E+00	0.0E+00
	Residual Handling	2,479.15	2.1E+04	NA	1.4E+01	7.4E+00	4.0E+01	1.3E-05	1.1E-03
	Sub-Total	210,438.89	1.20E+07	1.40E+08	3.39E+01	1.77E+02	4.16E+01	3.27E-03	2.63E-01
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**2.1E+05**	**1.2E+07**	**1.4E+08**	**3.4E+01**	**1.8E+02**	**4.2E+01**	**3.3E-03**	**2.6E-01**

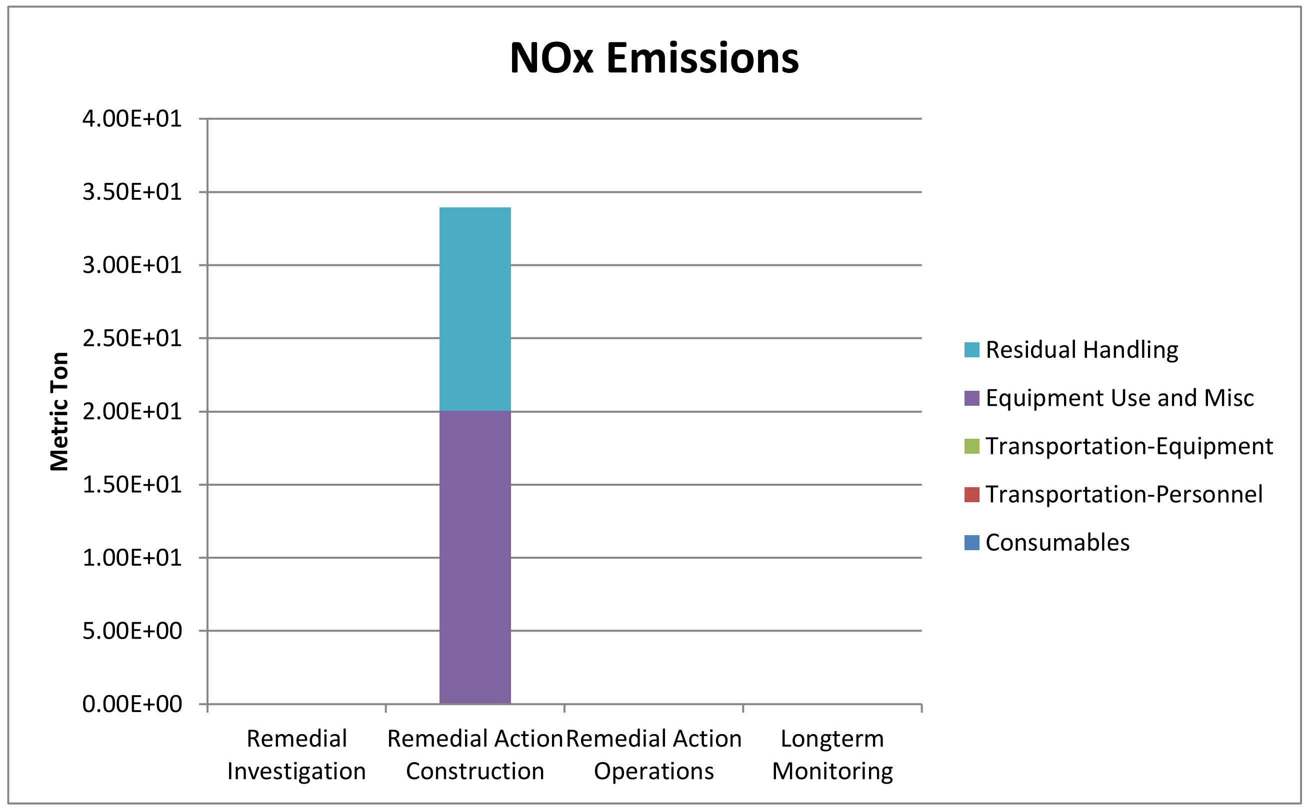
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.9E+05	2.2E+04	0.0E+00	0	2.1E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**1.9E+05**	**2.2E+04**	**0.0E+00**	**$0**	**2.1E+00**

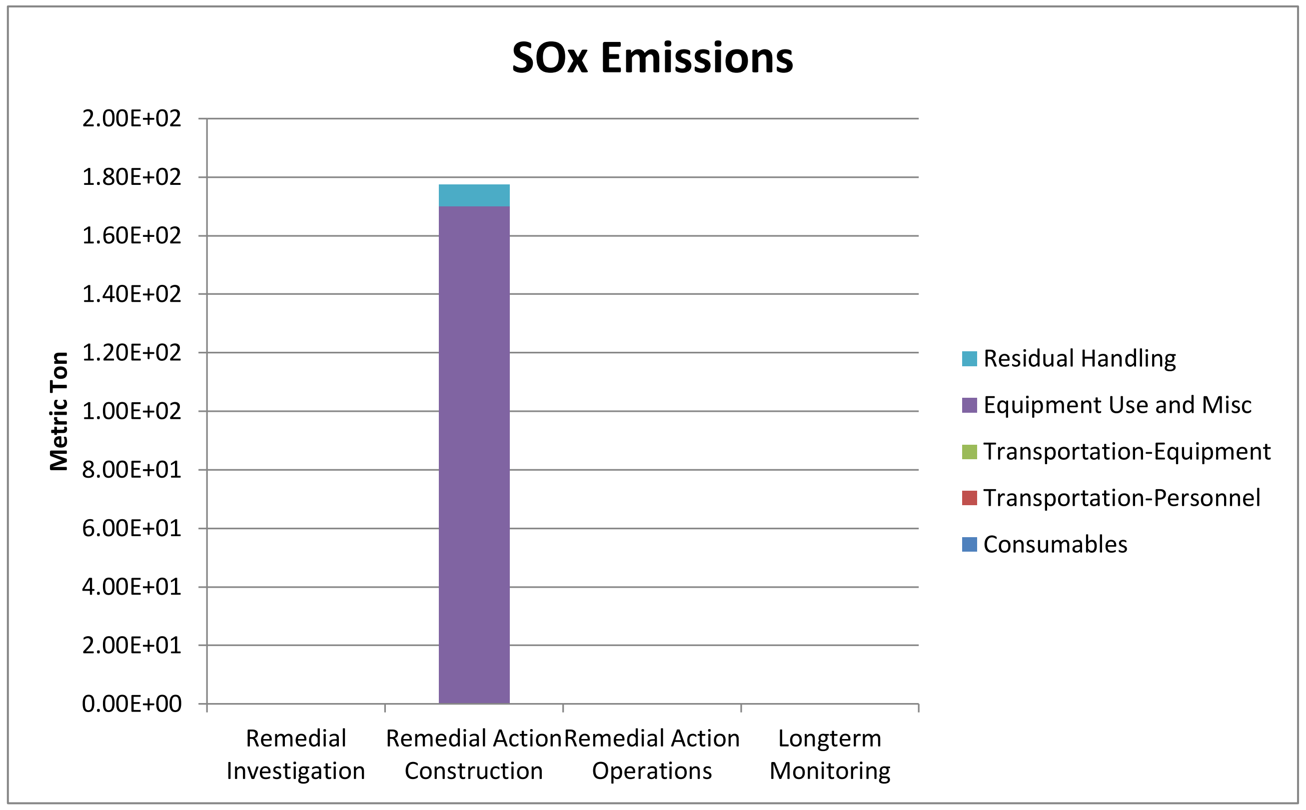
Total Cost with Footprint Reduction
$0

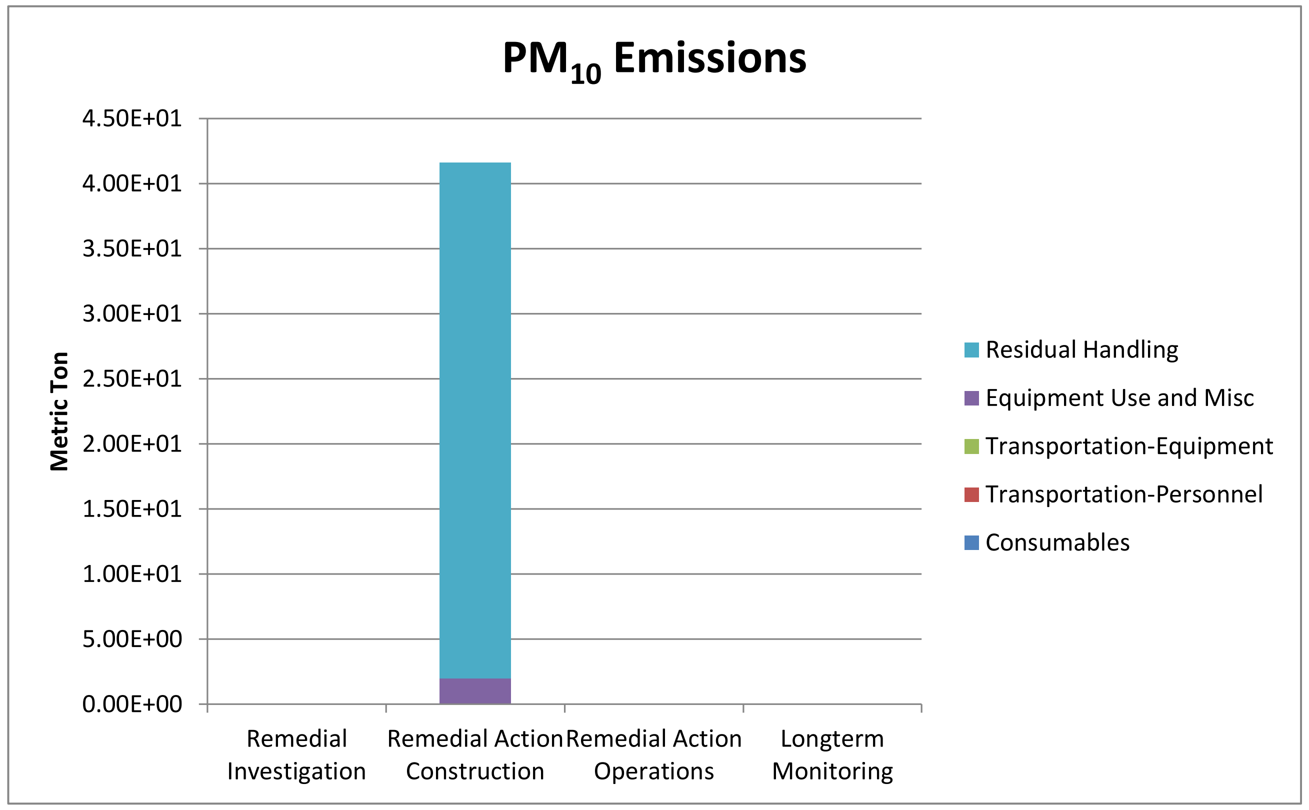

GHG Emissions
Metric Tons
250000.00
200000.00
150000.00
100000.00
50000.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

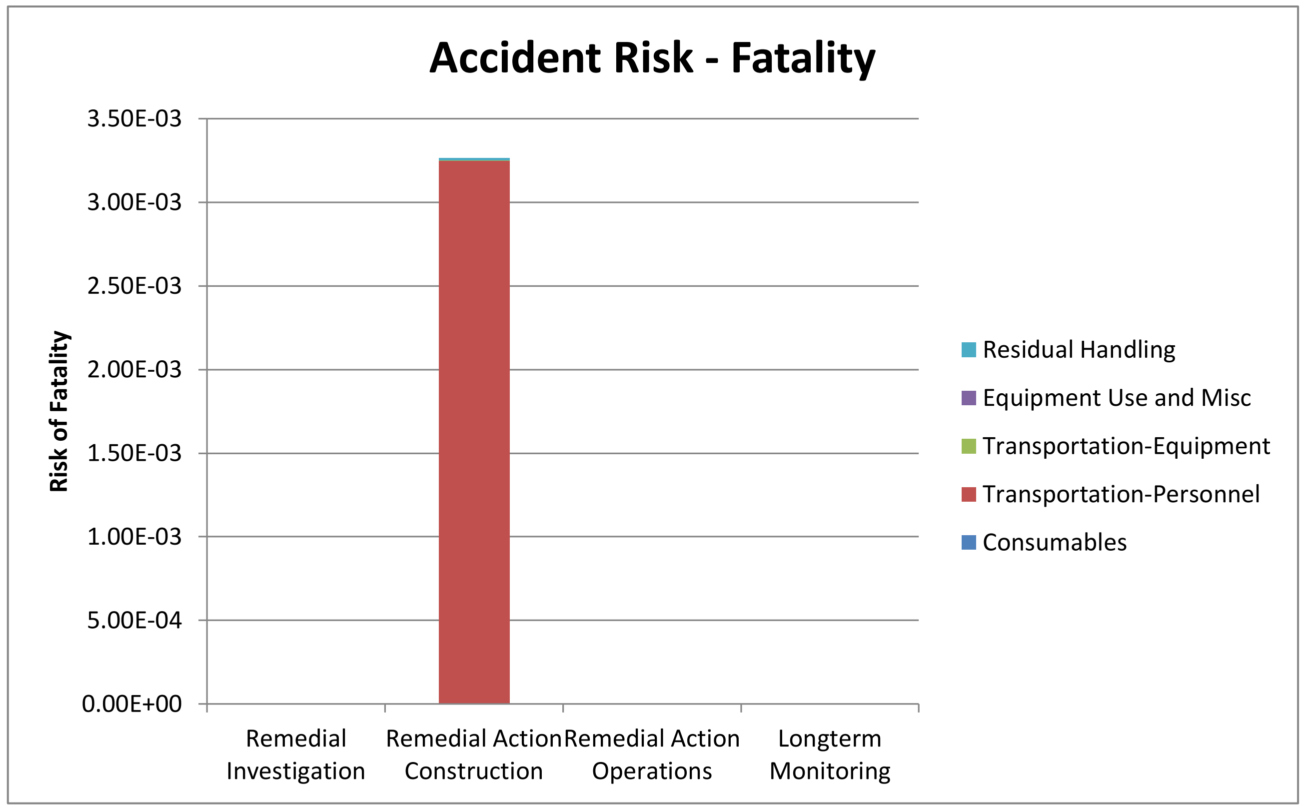

Total Energy Used
MMBTU
1.40E+07
1.20E+07
1.00E+07
8.00E+06
6.00E+06
4.00E+06
2.00E+06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

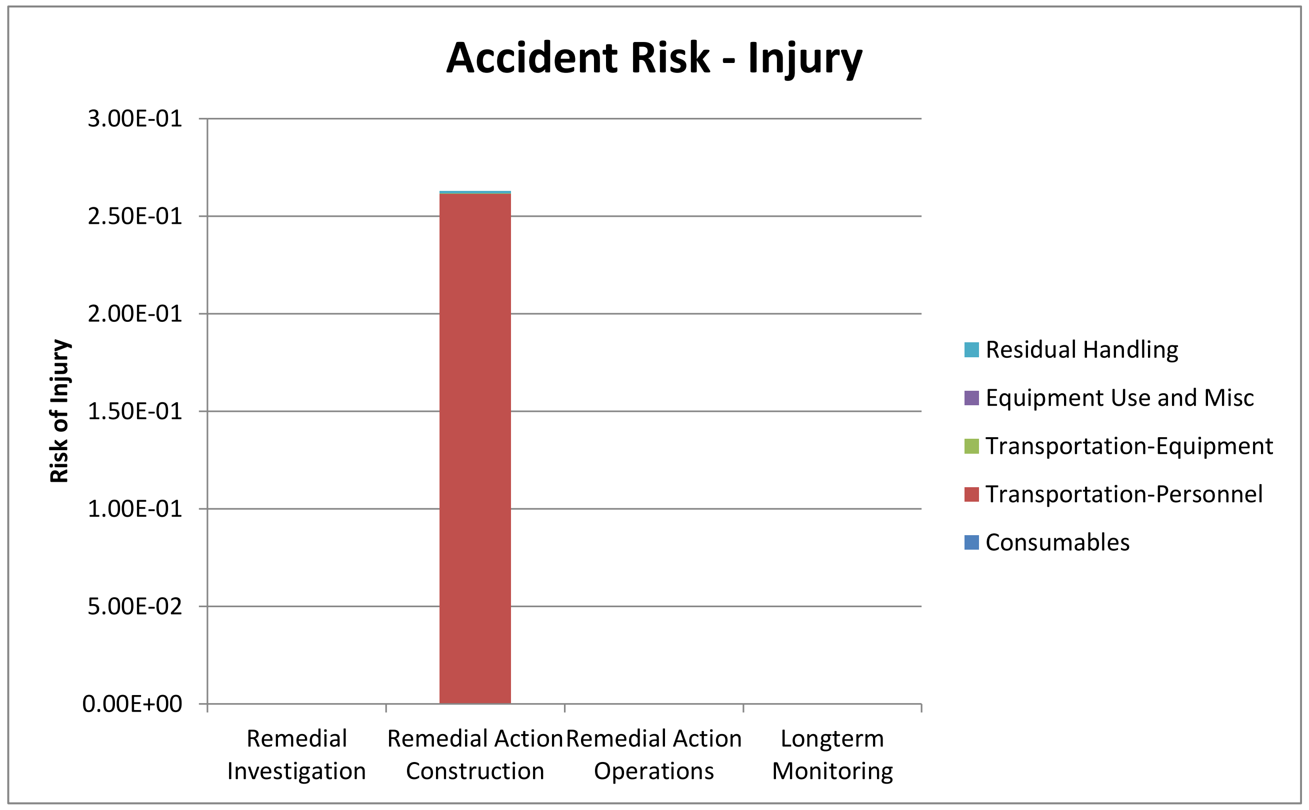

Water Consumption
Gallons
1.60E+08
1.40E+08
1.20E+08
1.00E+08
8.00E+07
6.00E+07
4.00E+07
2.00E+07
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

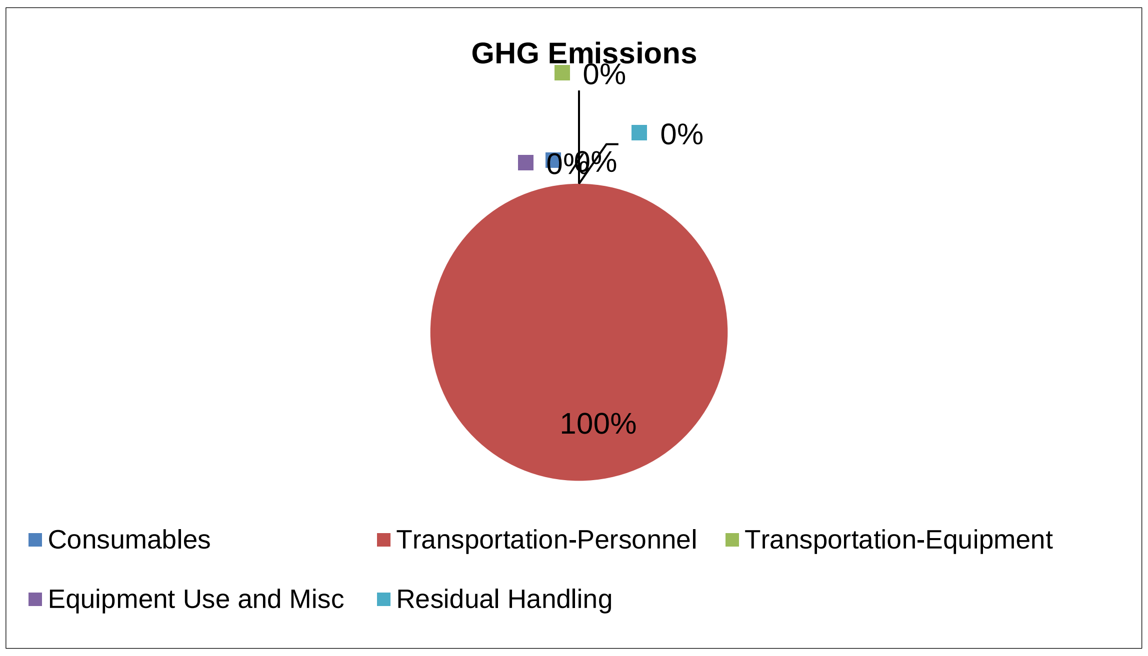

NOx Emissions
Metric Ton
4.00E+01
3.50E+01
3.00E+01
2.50E+01
2.00E+01
1.50E+01
1.00E+01
5.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

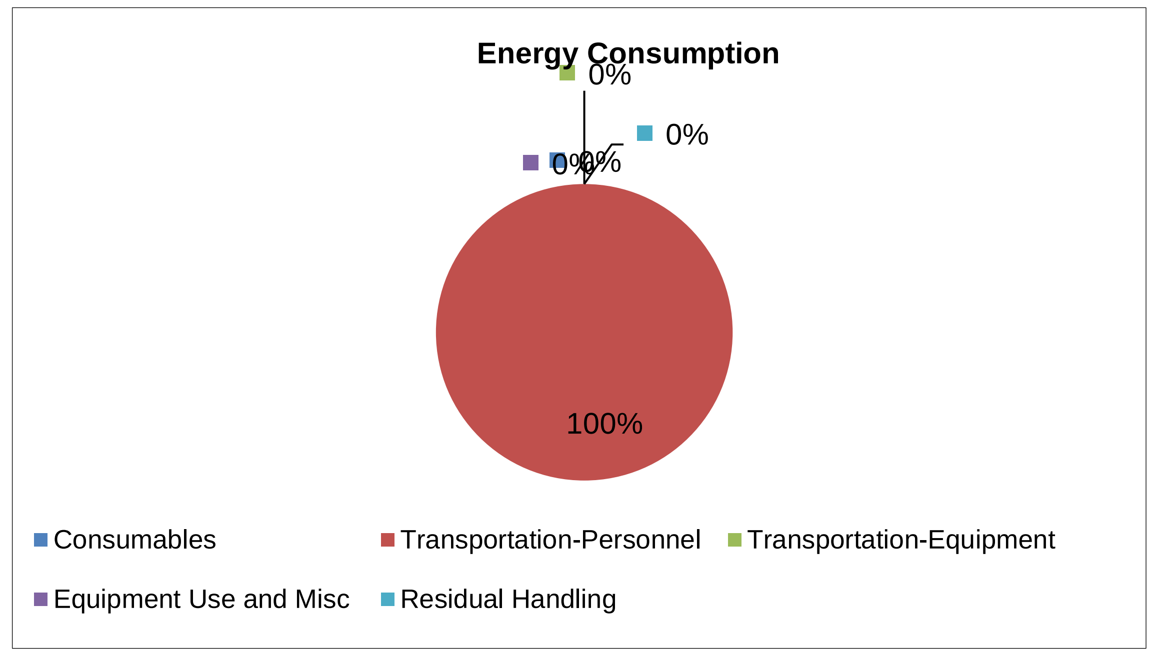

SOx Emissions
Metric Ton
2.00E+02
1.80E+02
1.60E+02
1.40E+02
1.20E+02
1.00E+02
8.00E+01
6.00E+01
4.00E+01
2.00E+01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

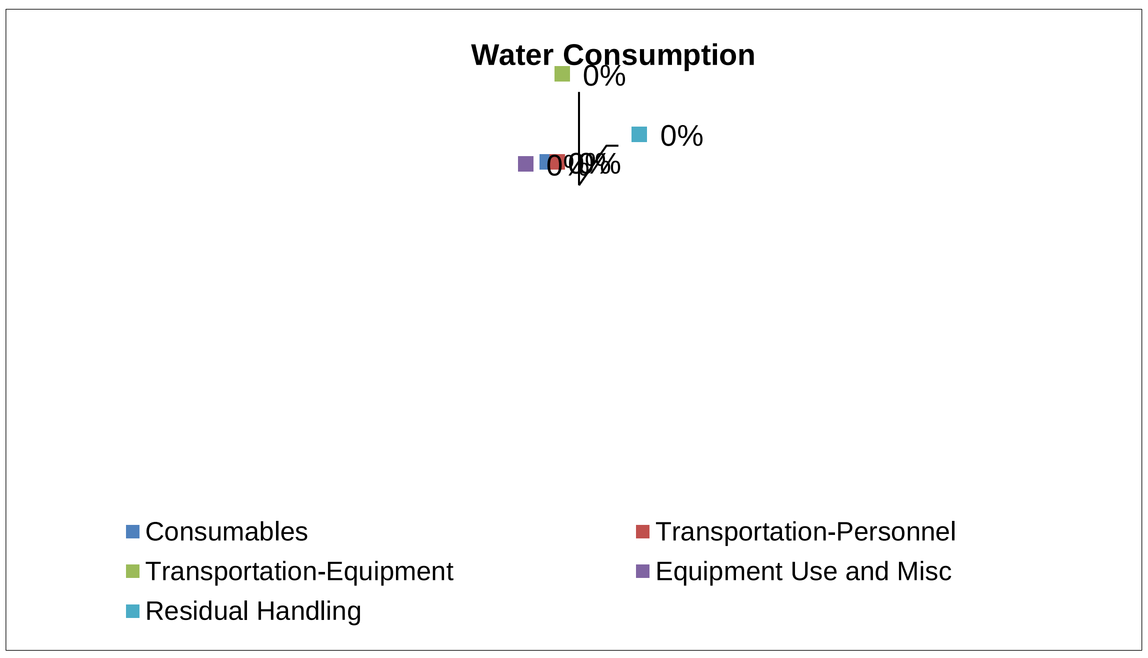

PM10 Emissions
Metric Ton
4.50E+01
4.00E+01
3.50E+01
3.00E+01
2.50E+01
2.00E+01
1.50E+01
1.00E+01
5.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

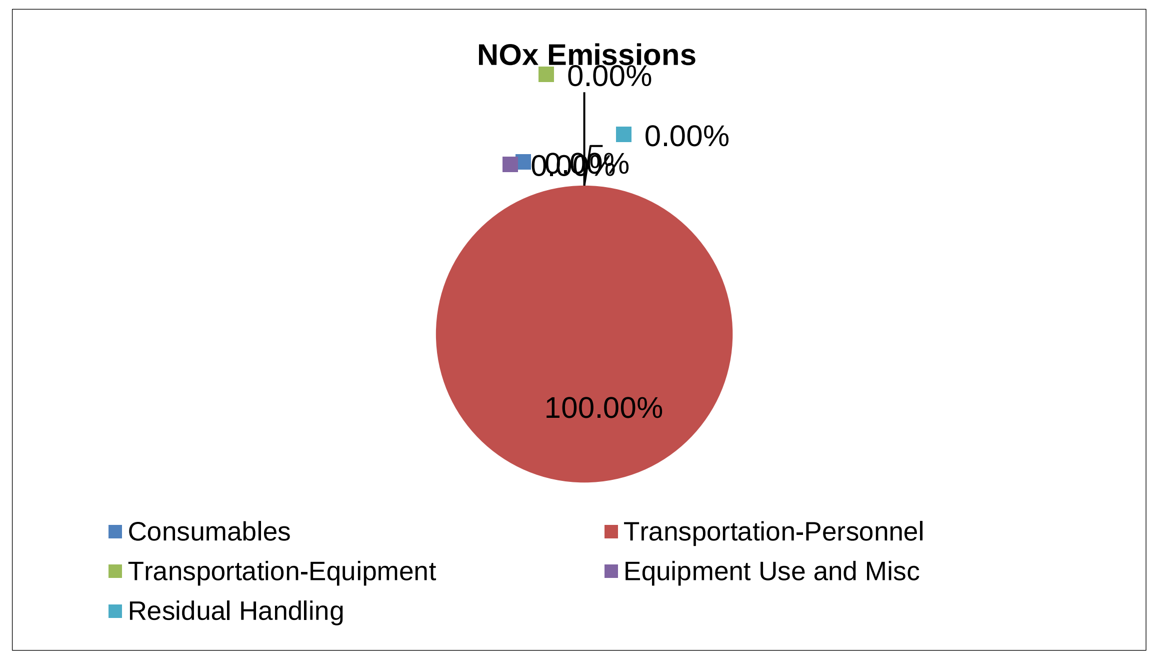

Accident Risk - Fatality
Risk of Fatality
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

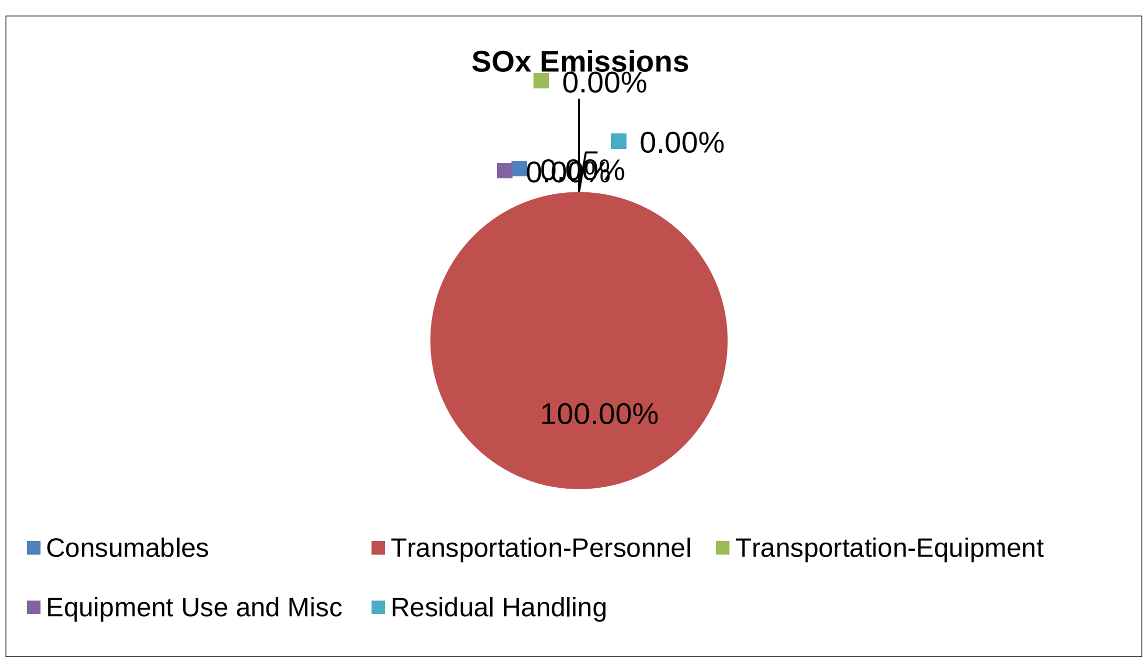

Accident Risk - Injury
Risk of Injury
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

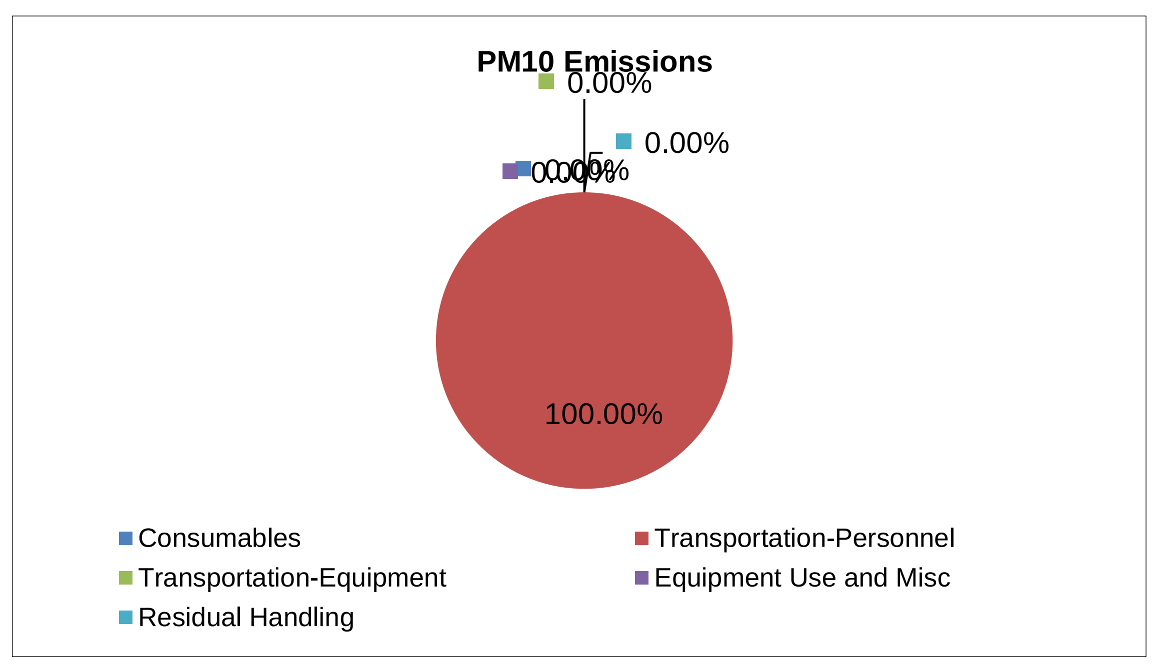

GHG Emissions
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

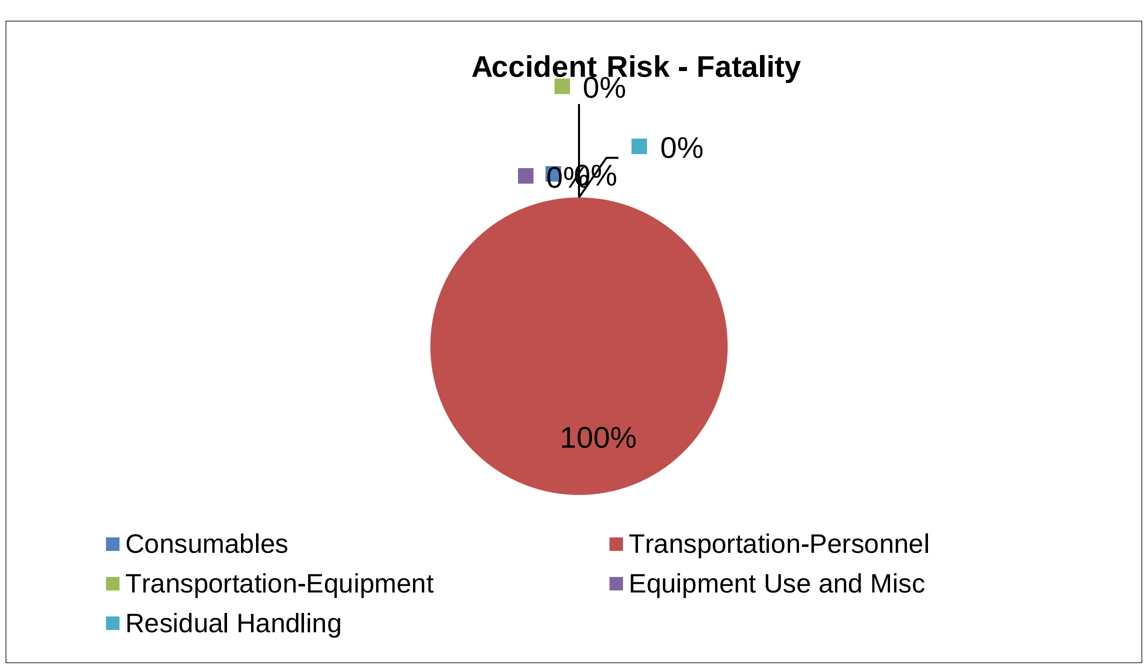

Energy Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

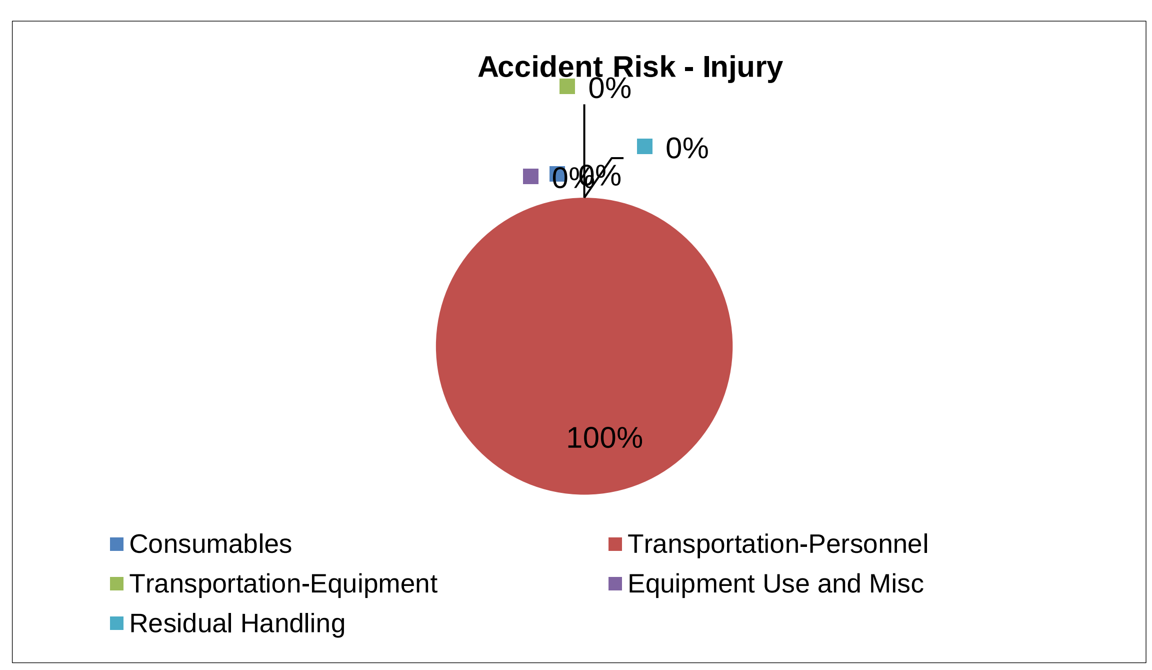

Water Consumption
0%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.00%
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
0.00%
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.00%
0.00%
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

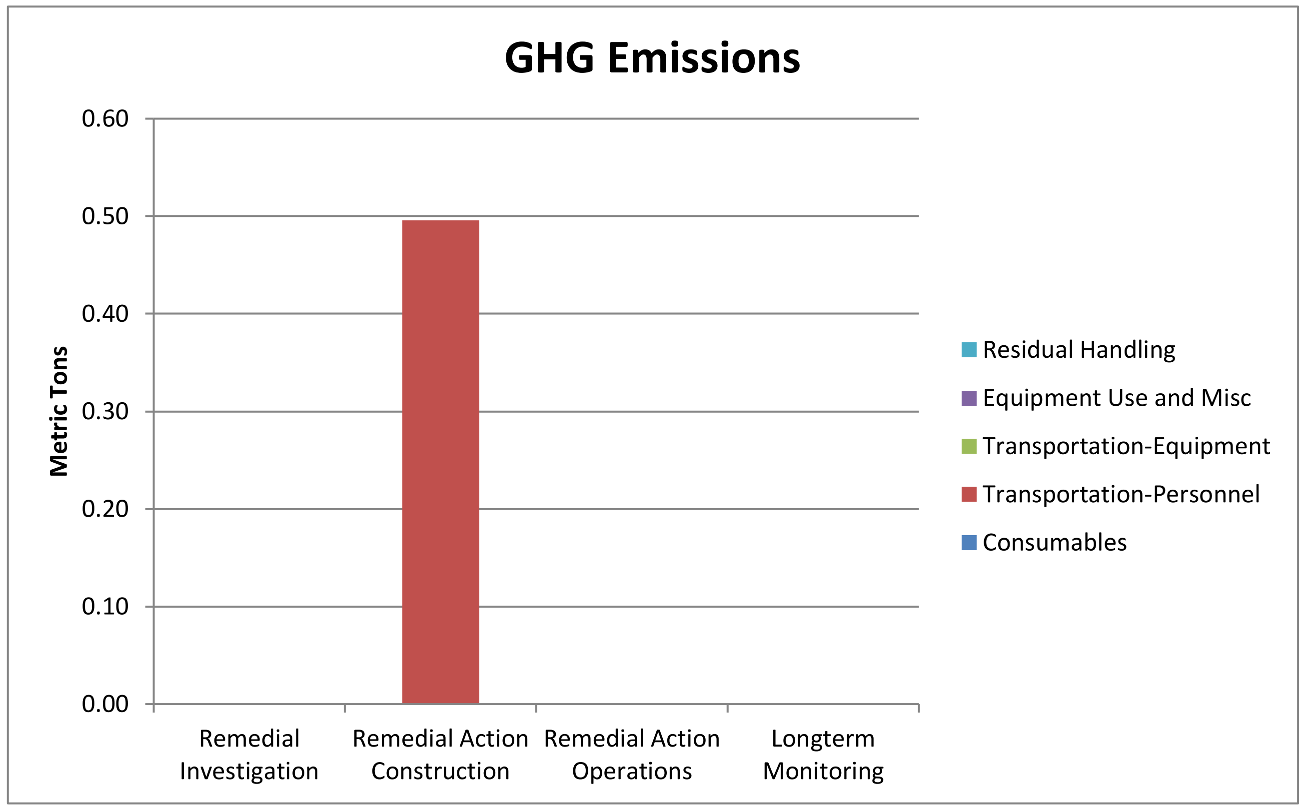

Accident Risk - Injury
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

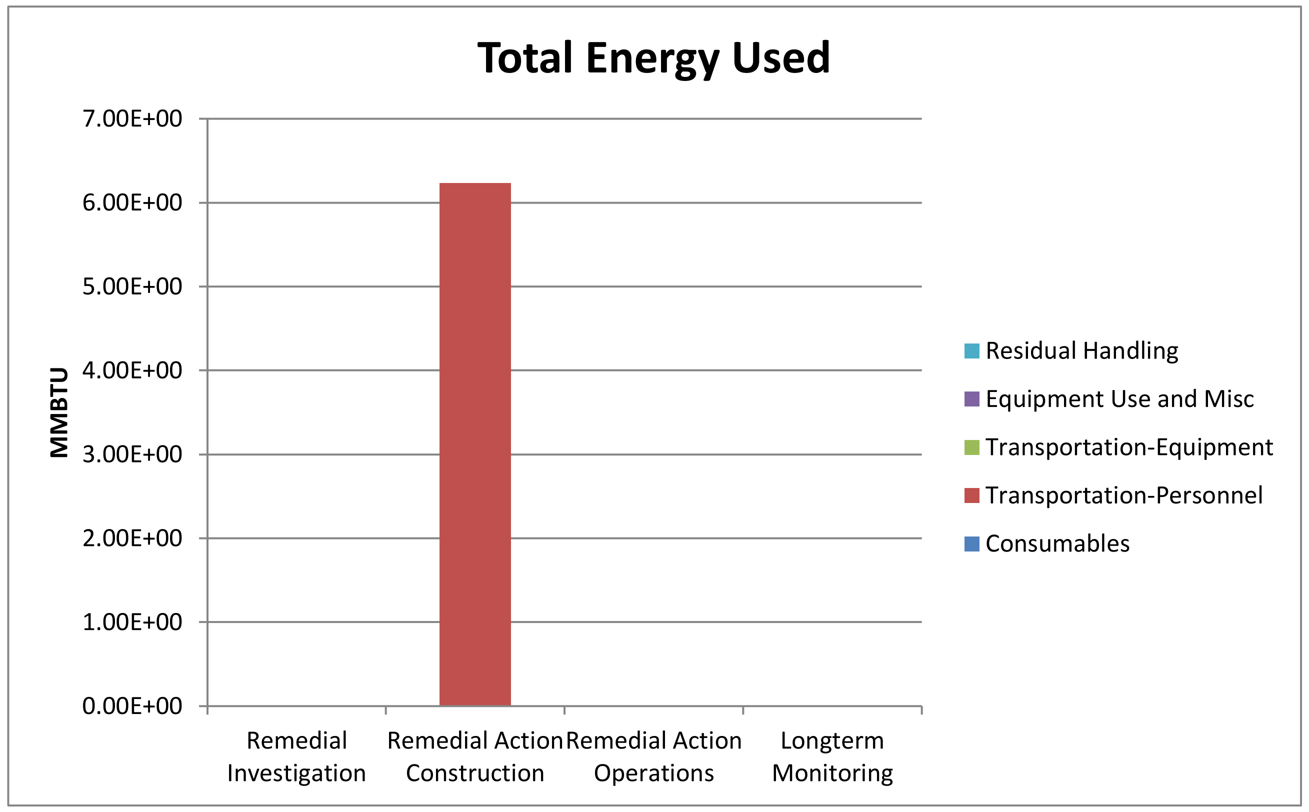
Sustainable Remediation - Environmental Footprint Summary

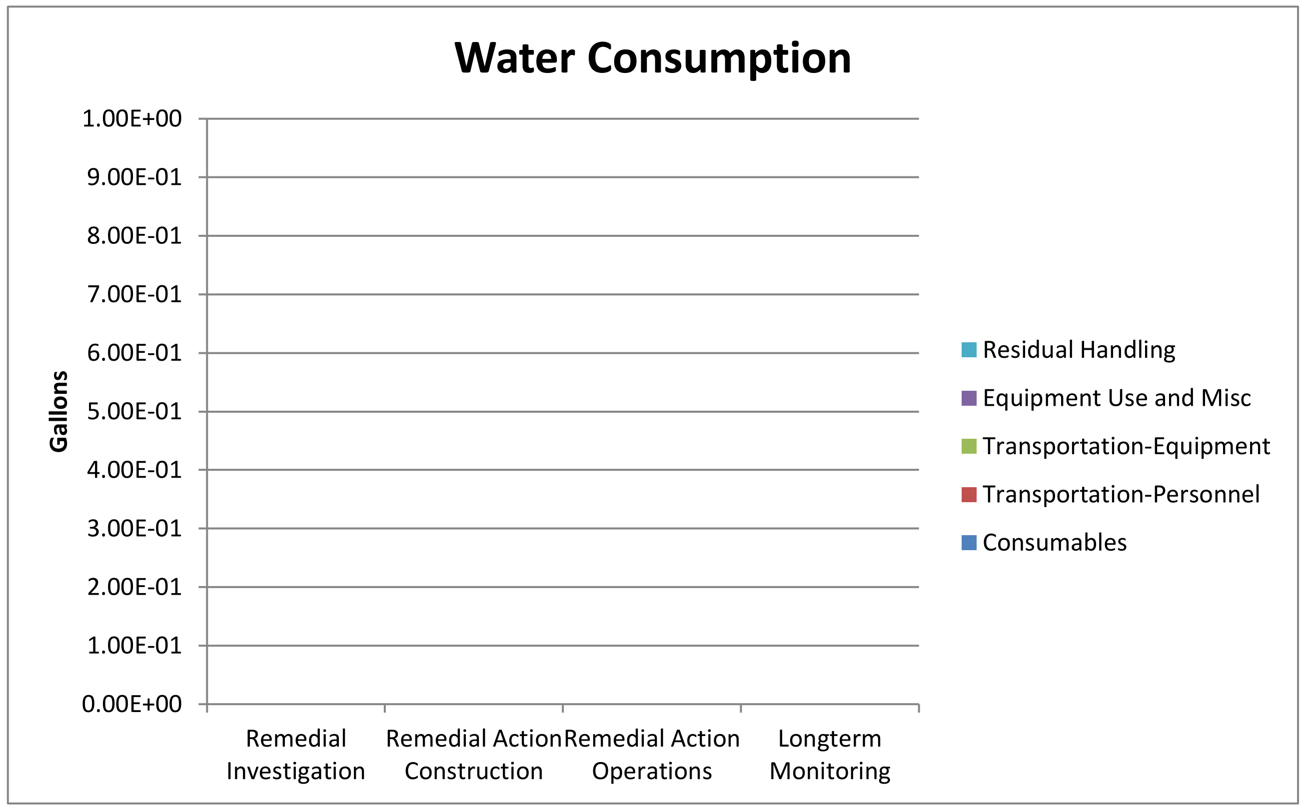
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.50	6.2E+00	NA	1.8E-04	6.5E-06	3.7E-05	1.0E-05	8.2E-04
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.50	6.23E+00	0.00E+00	1.83E-04	6.46E-06	3.72E-05	1.01E-05	8.16E-04
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**5.0E-01**	**6.2E+00**	**0.0E+00**	**1.8E-04**	**6.5E-06**	**3.7E-05**	**1.0E-05**	**8.2E-04**

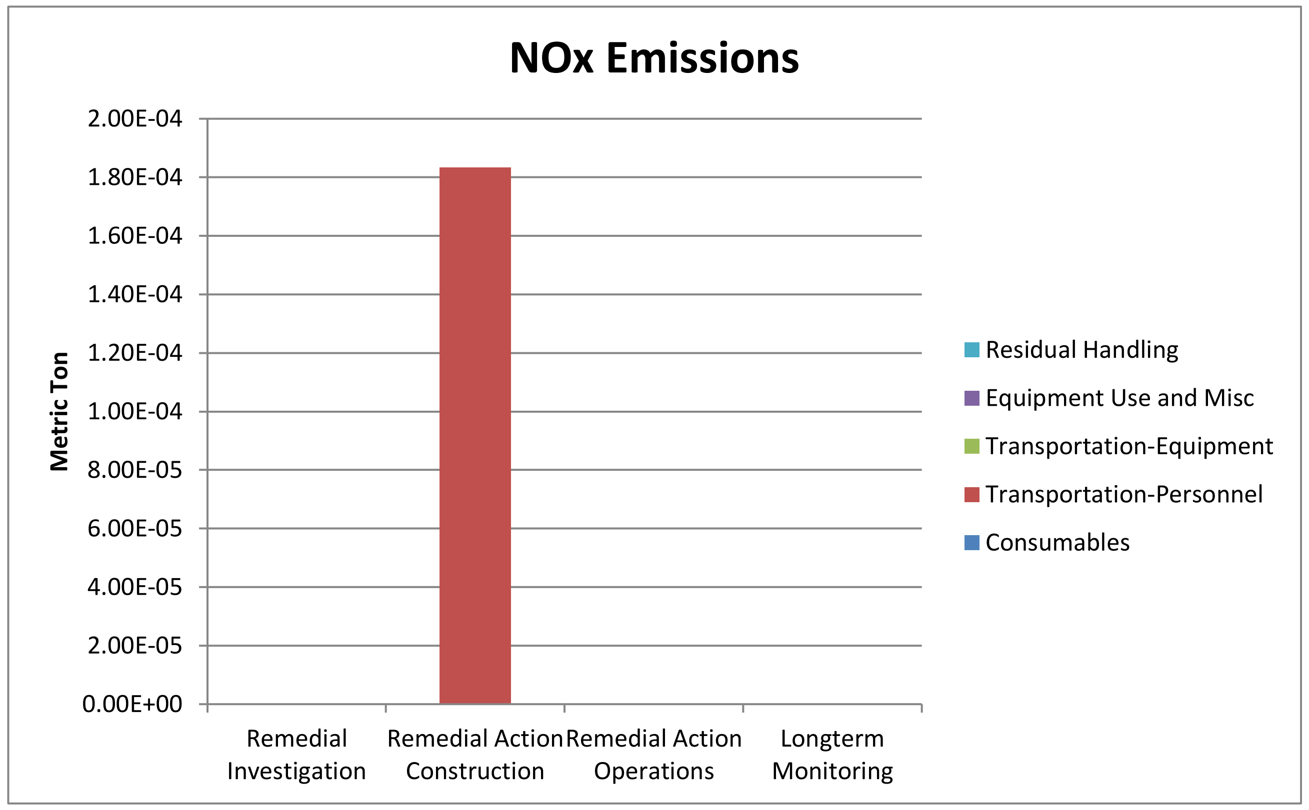
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	6.5E-03
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**6.5E-03**

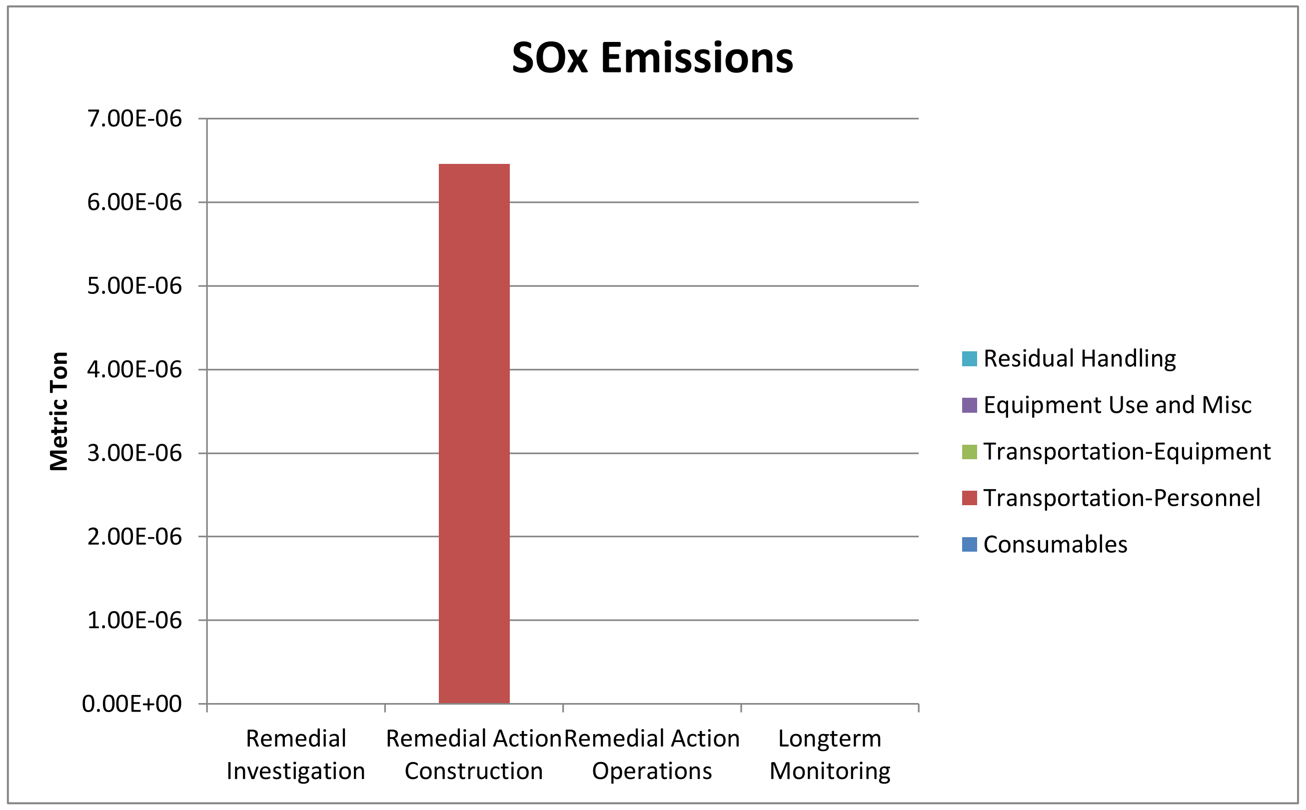
Total Cost with Footprint Reduction
$0


GHG Emissions
Metric Tons
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

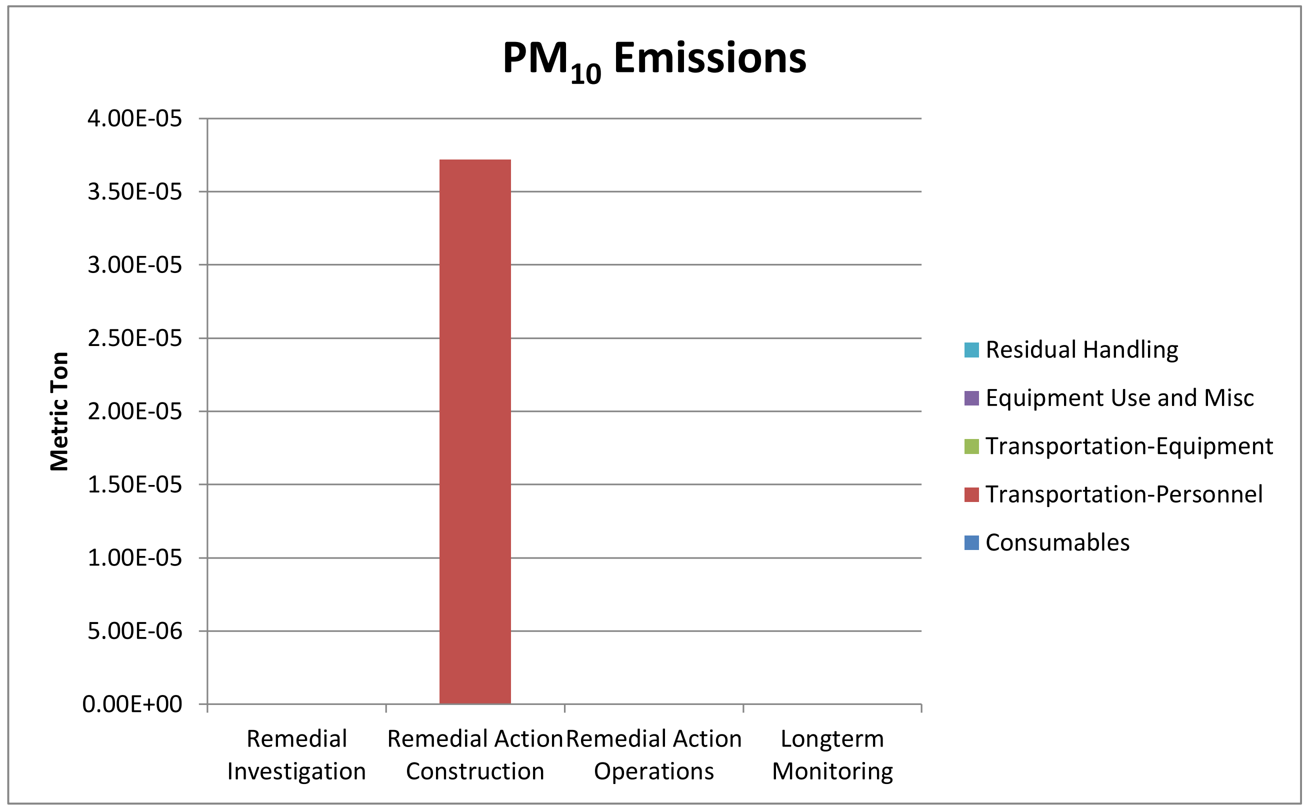

Total Energy Used
MMBTU
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Water Consumption
Gallons
1.00E+00
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

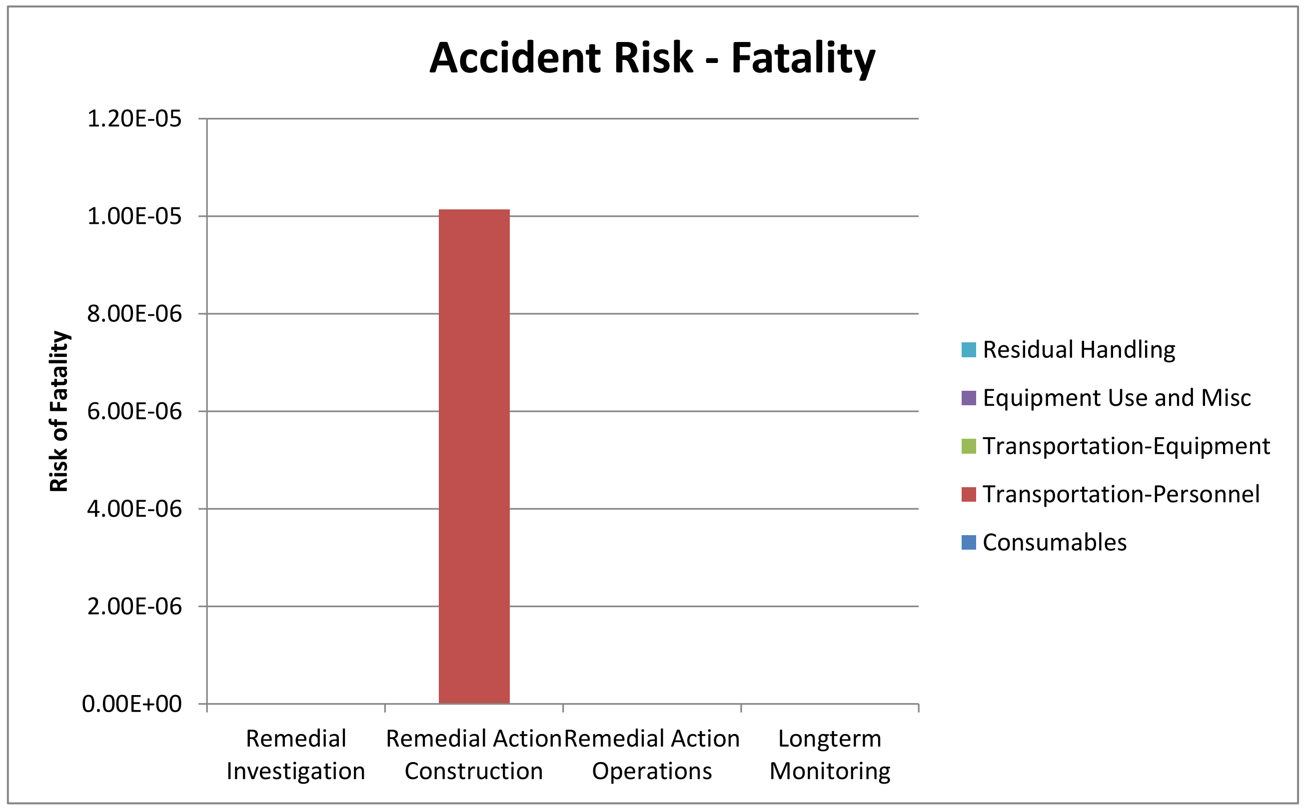

NOx Emissions
Metric Ton
2.00E-04
1.80E-04
1.60E-04
1.40E-04
1.20E-04
1.00E-04
8.00E-05
6.00E-05
4.00E-05
2.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables



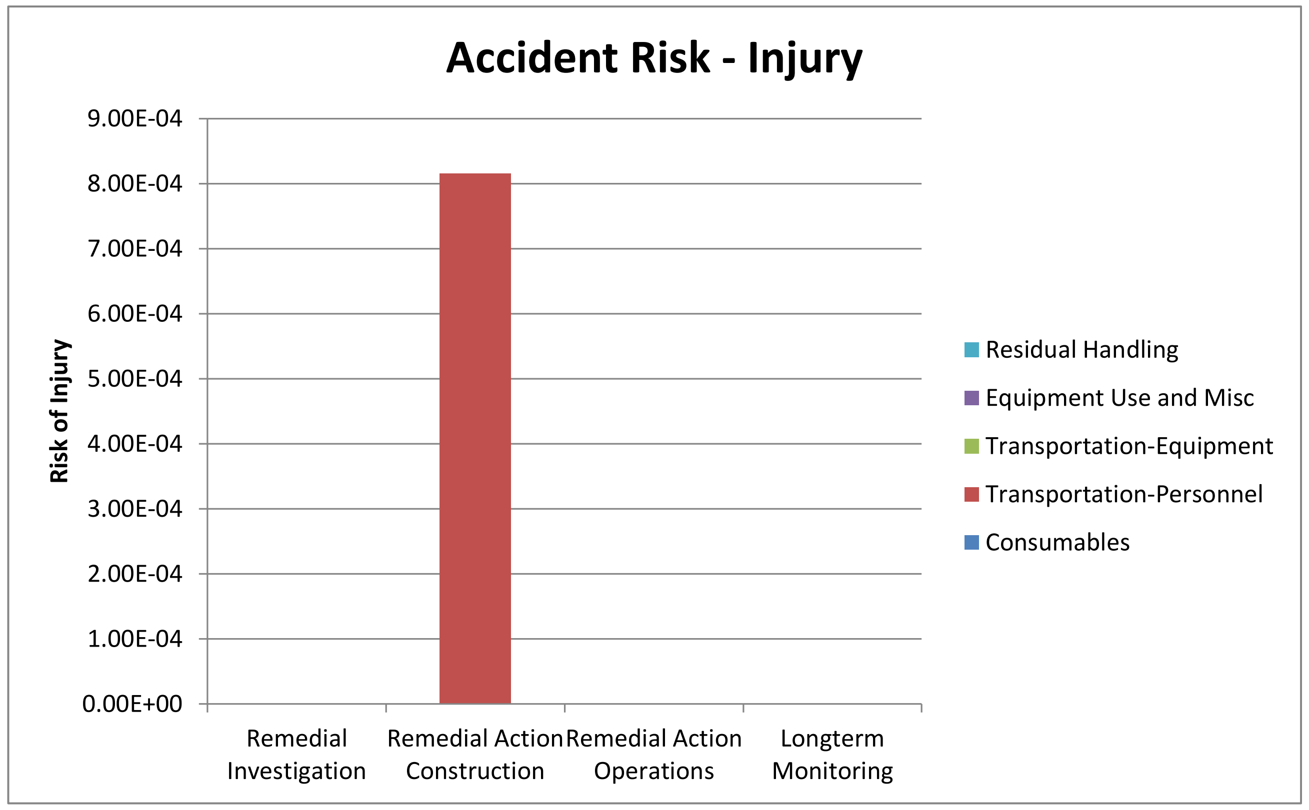
SOx Emissions
Metric Ton
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables



PM_{10} Emissions
Metric Ton
4.00E-05
3.50E-05
3.00E-05
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables



Accident Risk - Fatality
Risk of Fatality
1.20E-05
1.00E-05
8.00E-06
6.00E-06
4.00E-06
2.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables



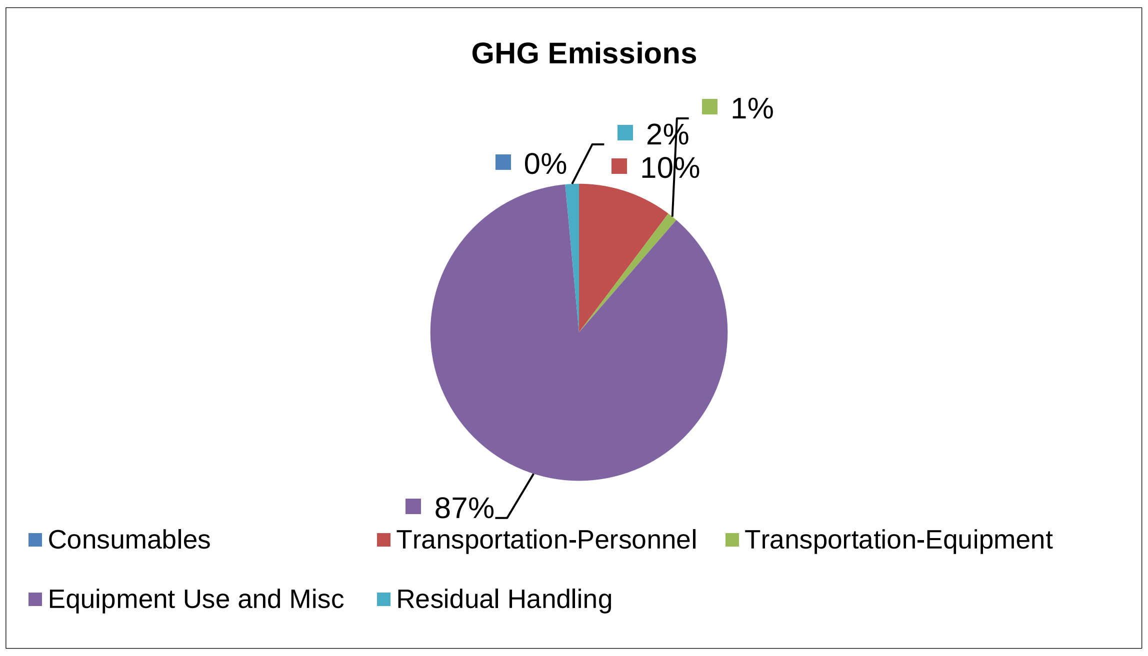
Accident Risk - Injury
Risk of Injury
9.00E-04
8.00E-04
7.00E-04
6.00E-04
5.00E-04
4.00E-04
3.00E-04
2.00E-04
1.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

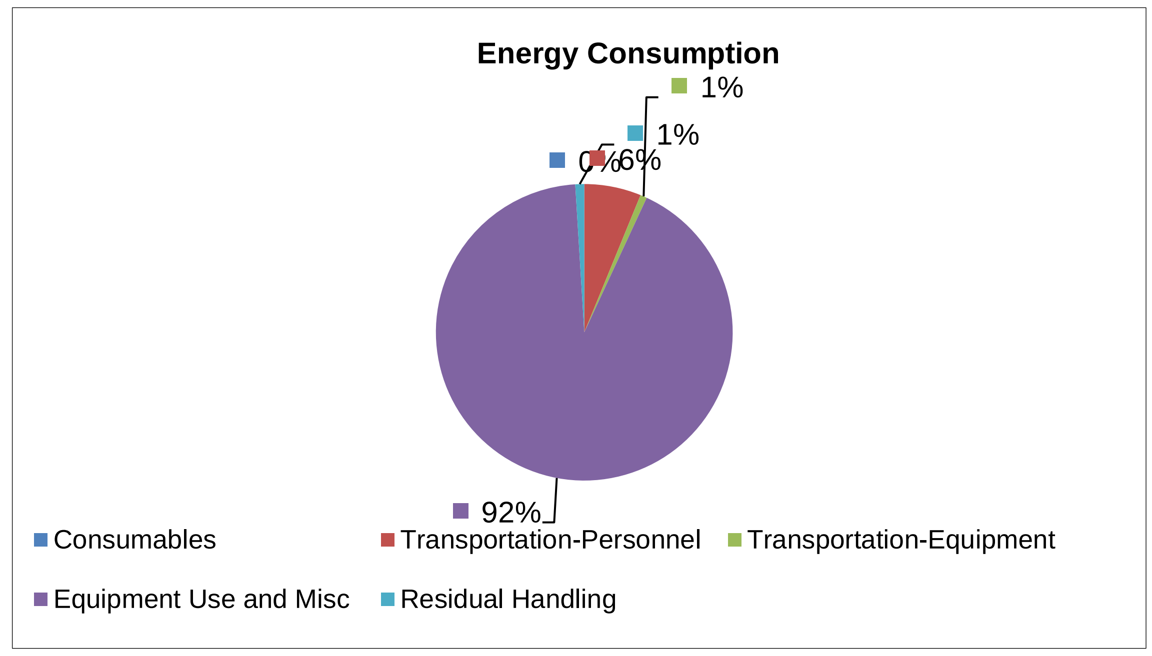
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	Materials								Tonnes				MWhr	gal x 1000
RAC	solvent wells	PVC	2 inch dia, PVC, 0.72 lbs/ft	300.00	lft	0.49	0.24	0.00	0.00	0.00	0.00	0.00	8.93	0.37
RAC	Monitoring Wells, 2" dia	PVC	1 inch dia, PVC, 0.33 lbs/ft	1,500.00	lft	1.12	0.56	0.00	0.01	0.00	0.00	0.00	20.47	0.85
RAC	Equipment Decon Pad	HDPE	assume HDPE, 25ft X 25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.01	0.00	0.00	0.00	9.55	0.26
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	1,471.00	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Monitoring Wells Head Compl	PVC	6 well heads, Assume PVC, 5 lb per head	30.00	lbs	0.07	0.03	0.00	0.00	0.00	0.00	0.00	1.24	0.05
	Subtotal					**3.31**	**1.72**	**0.00**	**0.02**	**0.00**	**0.01**	**0.00**	**40.20**	**1.55**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	6 SVE wells, 80% utilization	64.00	hrs	1.03	1.00	0.00	0.00	0.01	0.00	0.00	7.82	
	Subtotal					**1.03**	**1.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**7.82**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**4**	**3**	**0.00**	**0.02**	**0.01**	**0.01**	**0.00**	**48**	**2**

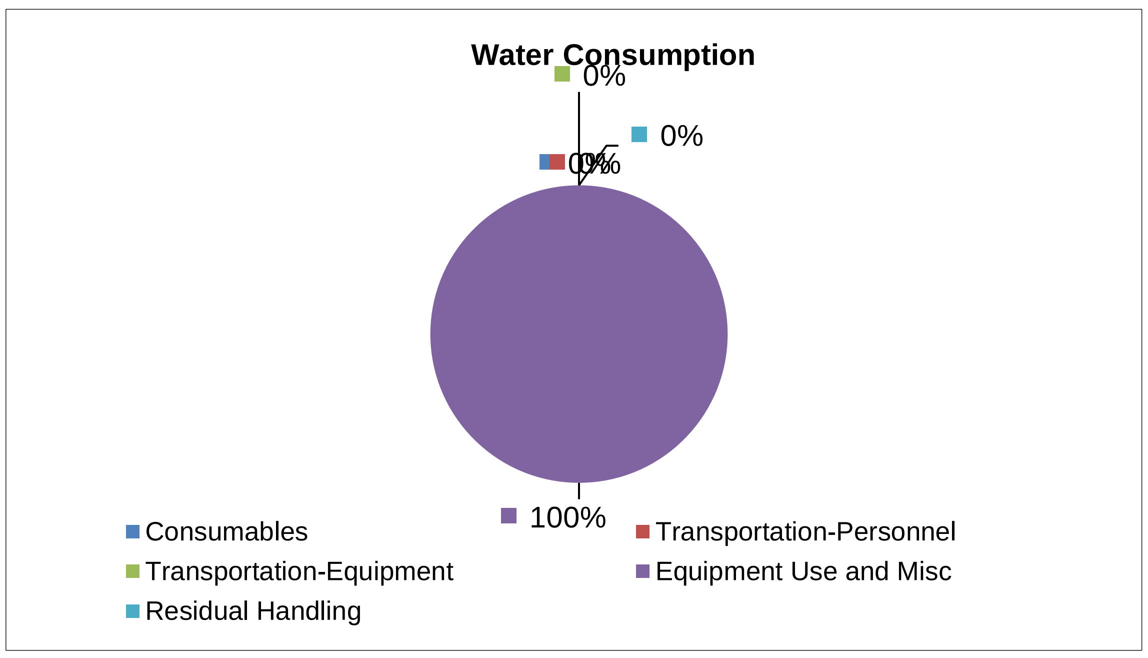
Alternative 1
Values Input into SiteWise as "Other"

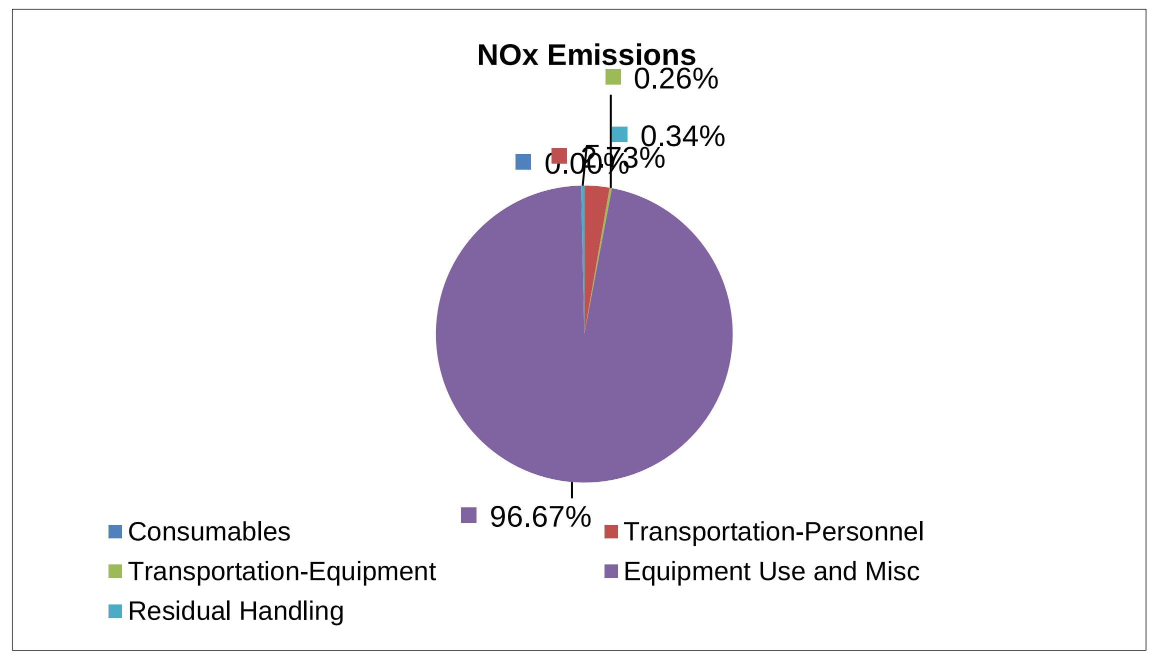
Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	4.34	2.72	1.26	0.36	0.01	0.01	0.00	163.86	1,546.47
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

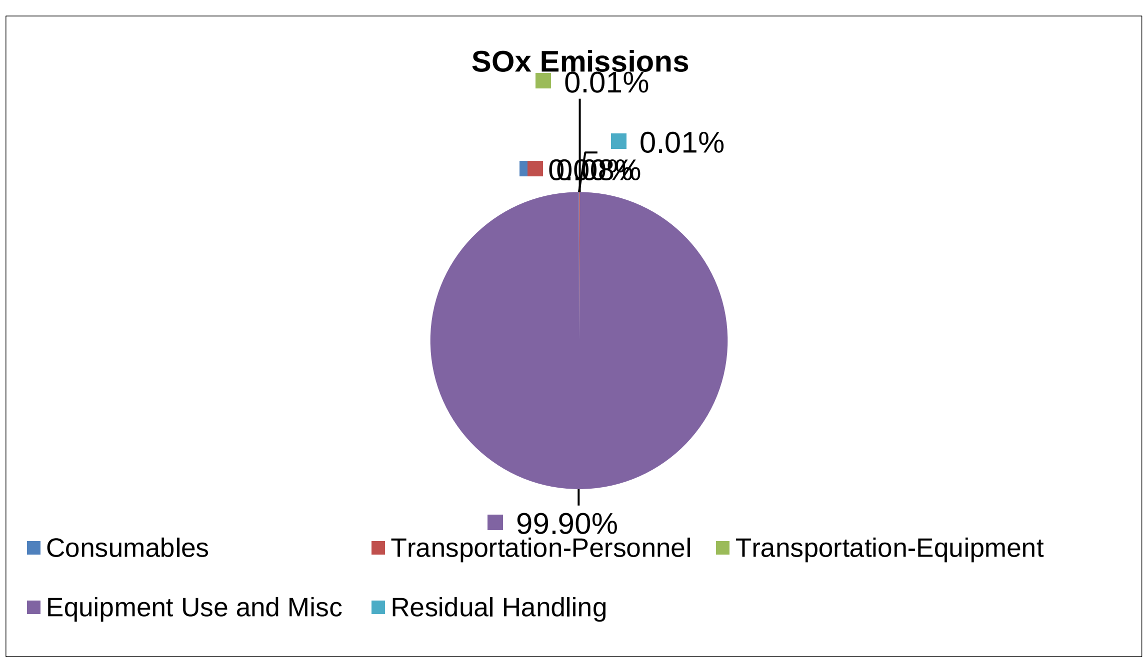
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

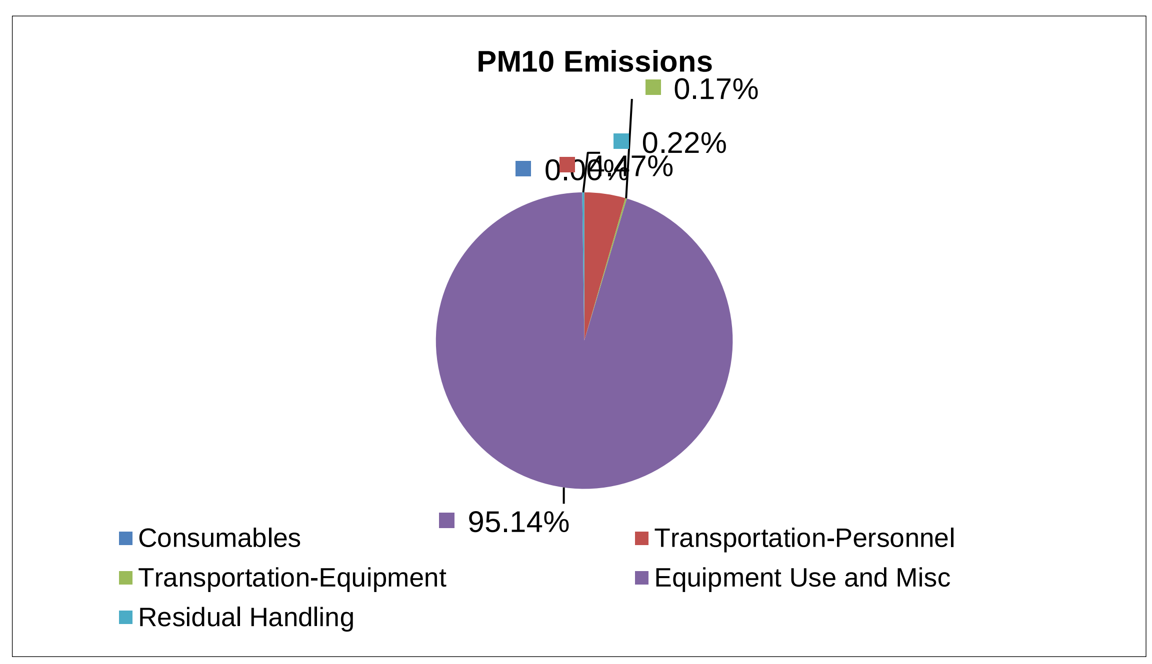

GHG Emissions
0%
2%
1%
10%
87%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

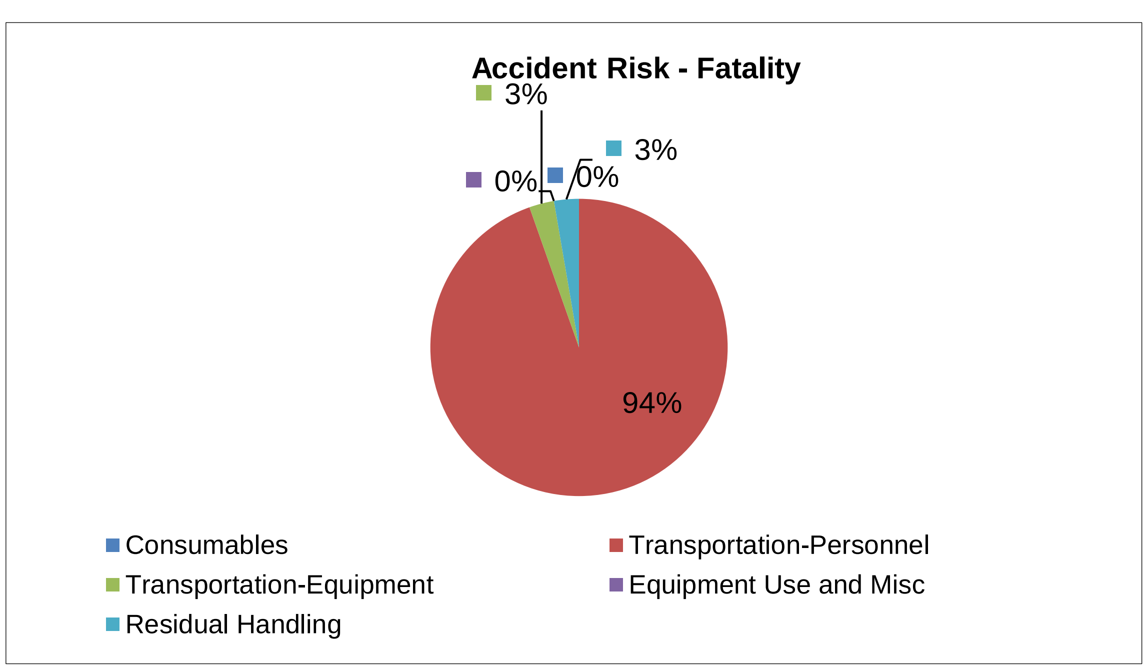

Energy Consumption
1%
1%
6%
92%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

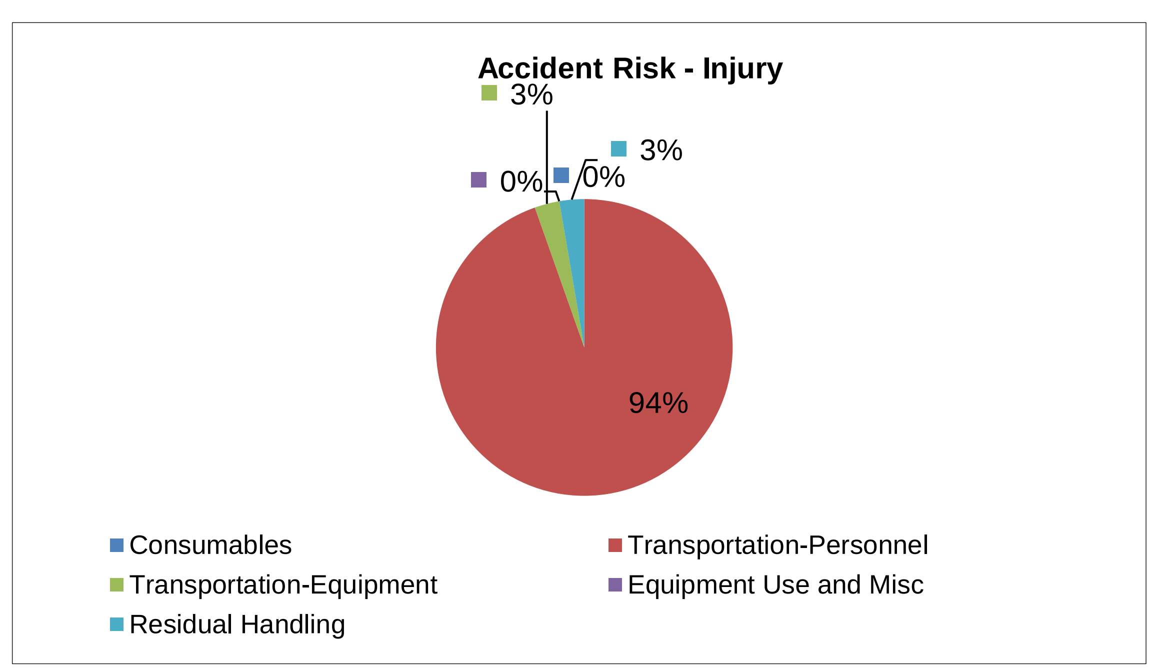

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.26%
0.34%
96.67%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.01%
0.01%
99.90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.17%
0.22%
95.14%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
3%
0%
0%
3%
94%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

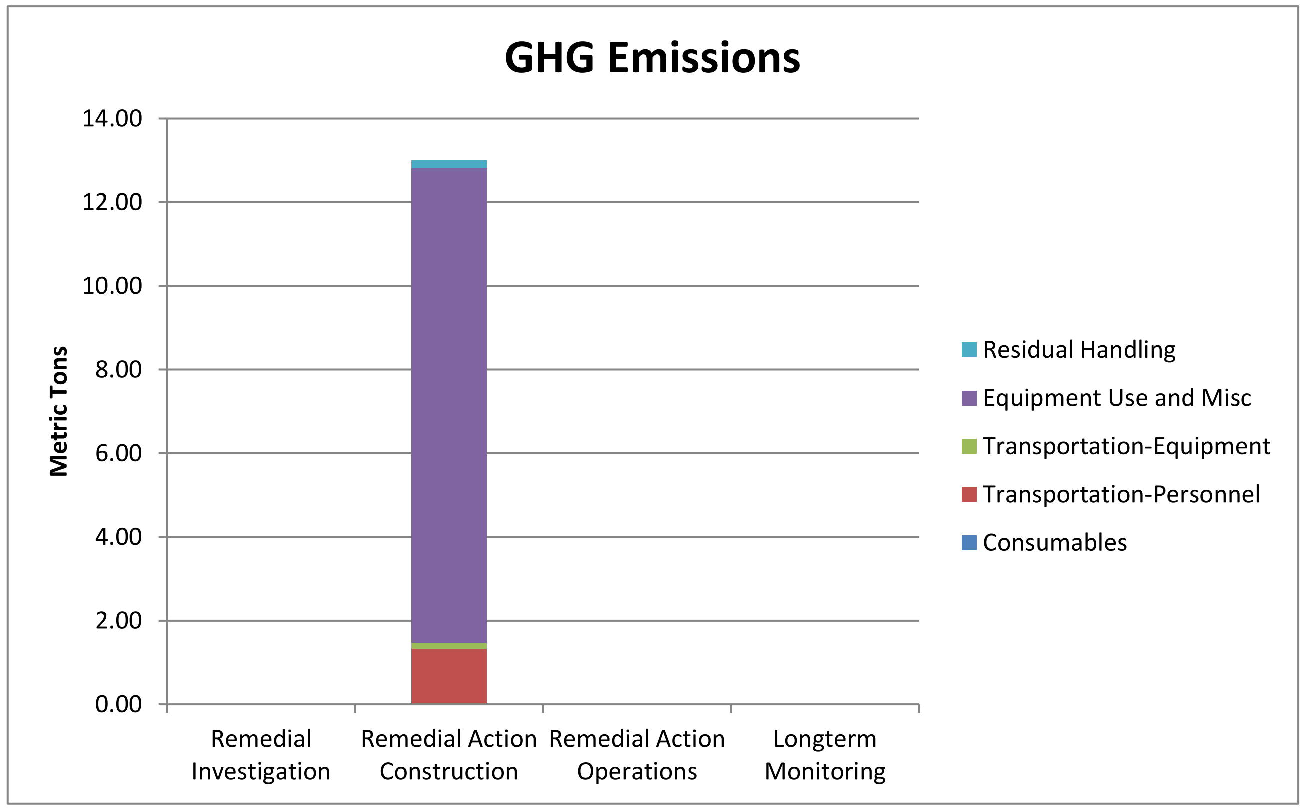

Accident Risk - Injury
3%
0%
0%
3%
94%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

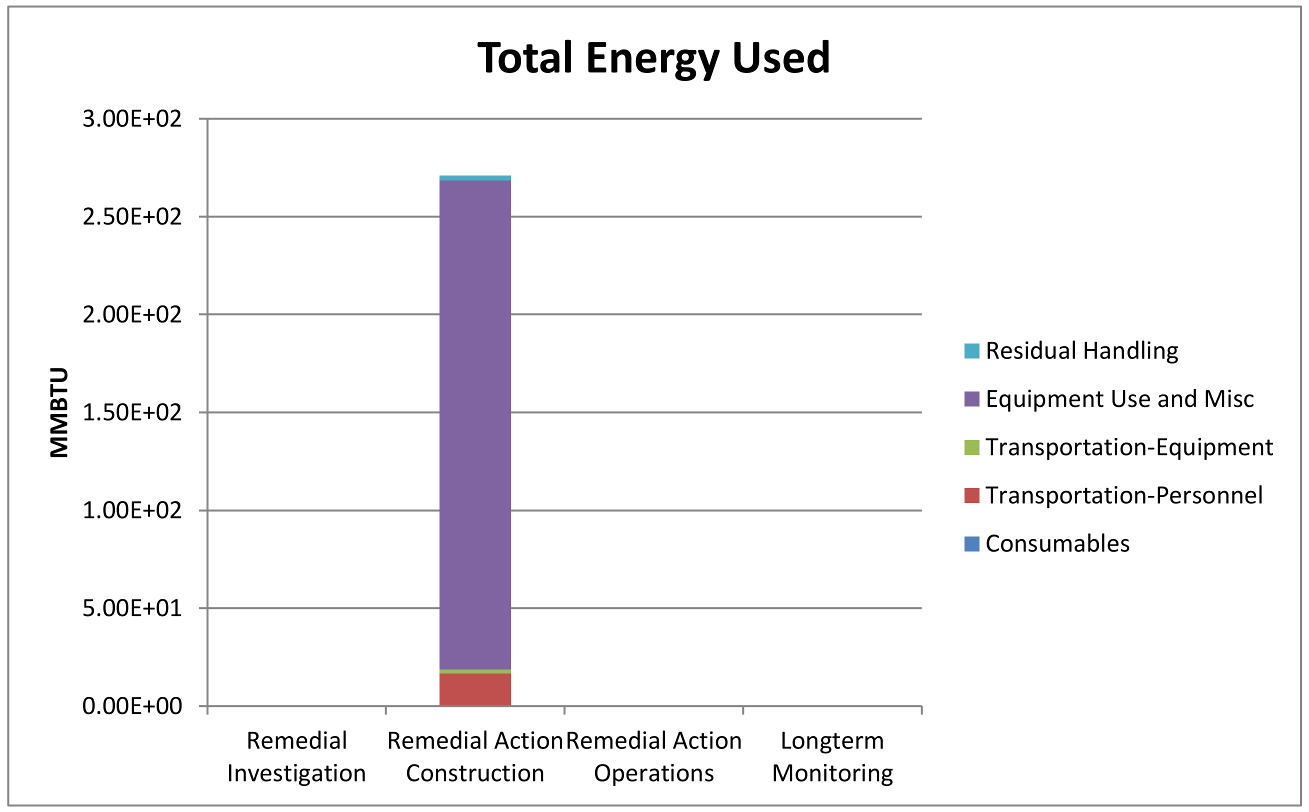
Sustainable Remediation - Environmental Footprint Summary

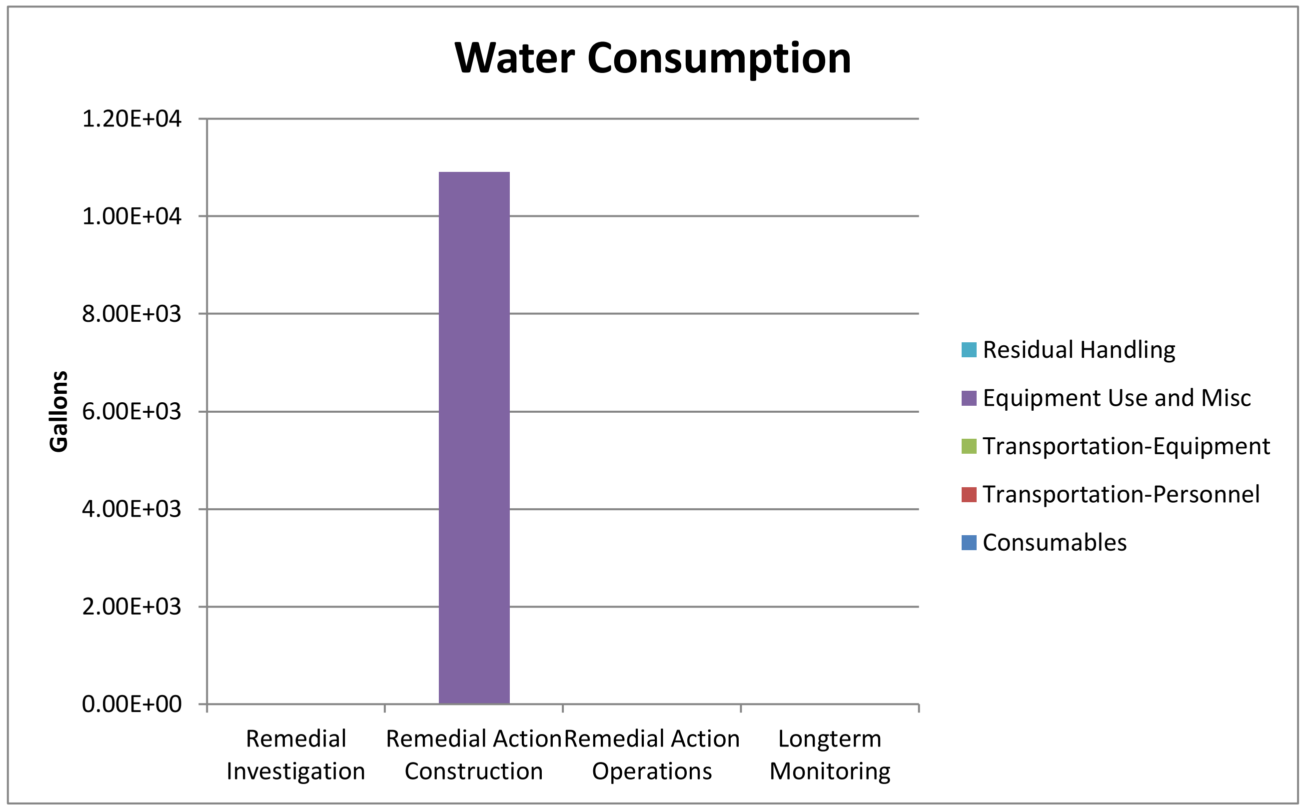
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.33	1.7E+01	NA	4.9E-04	1.7E-05	1.0E-04	2.7E-05	2.2E-03
	Transportation-Equipment	0.14	2.0E+00	NA	4.6E-05	1.9E-06	3.7E-06	7.8E-07	6.3E-05
	Equipment Use and Misc	11.33	2.5E+02	1.1E+04	1.7E-02	2.2E-02	2.1E-03	0.0E+00	0.0E+00
	Residual Handling	0.19	2.6E+00	NA	6.2E-05	2.5E-06	5.0E-06	7.8E-07	6.3E-05
	Sub-Total	13.00	2.71E+02	1.09E+04	1.80E-02	2.18E-02	2.24E-03	2.89E-05	2.32E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**1.3E+01**	**2.7E+02**	**1.1E+04**	**1.8E-02**	**2.2E-02**	**2.2E-03**	**2.9E-05**	**2.3E-03**

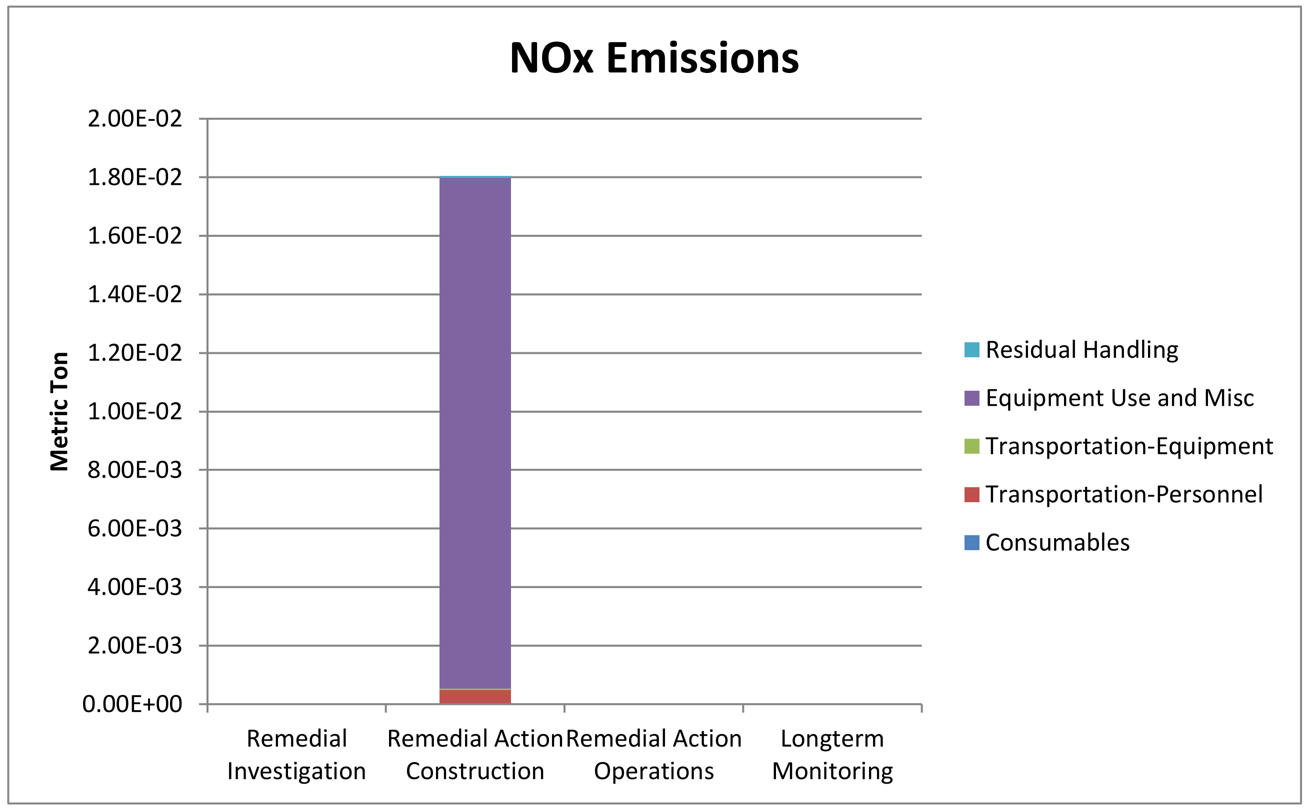
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	1.9E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**1.9E-02**

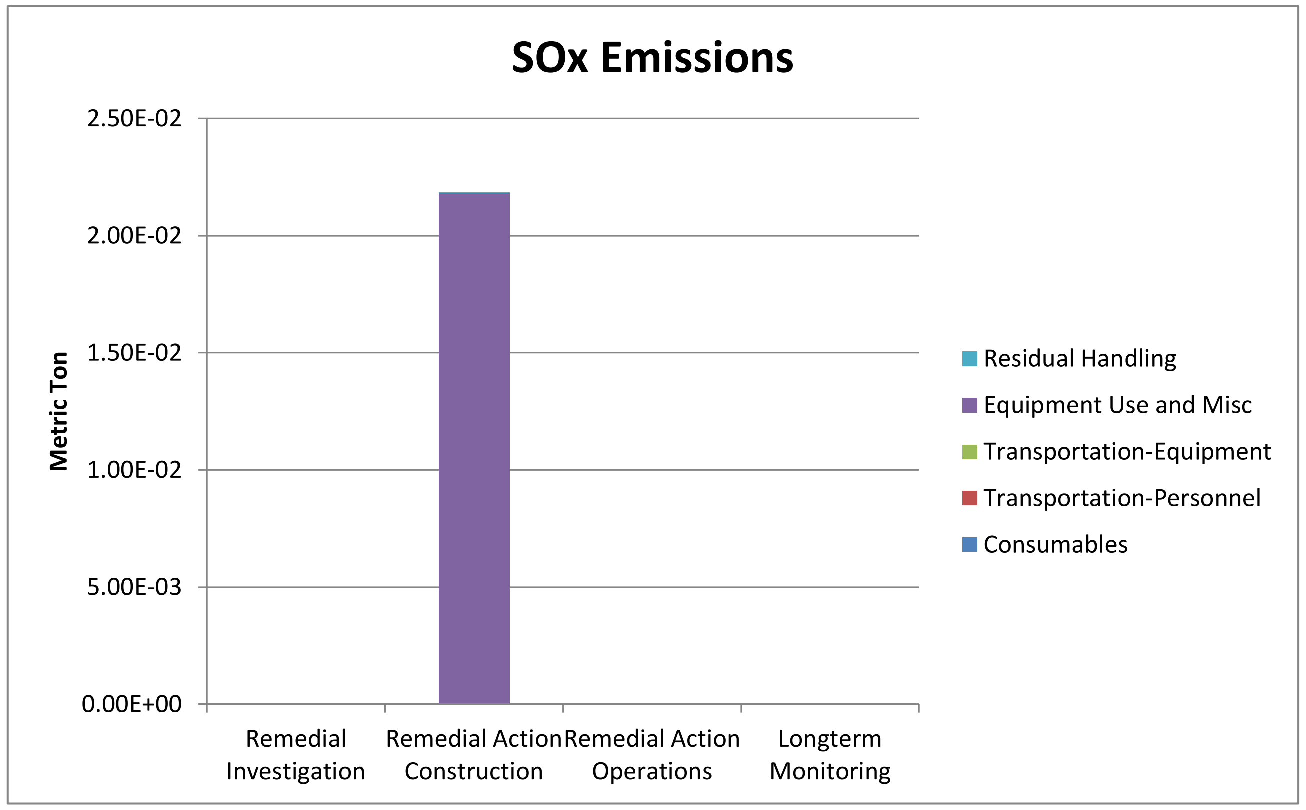
Total Cost with Footprint Reduction
$0

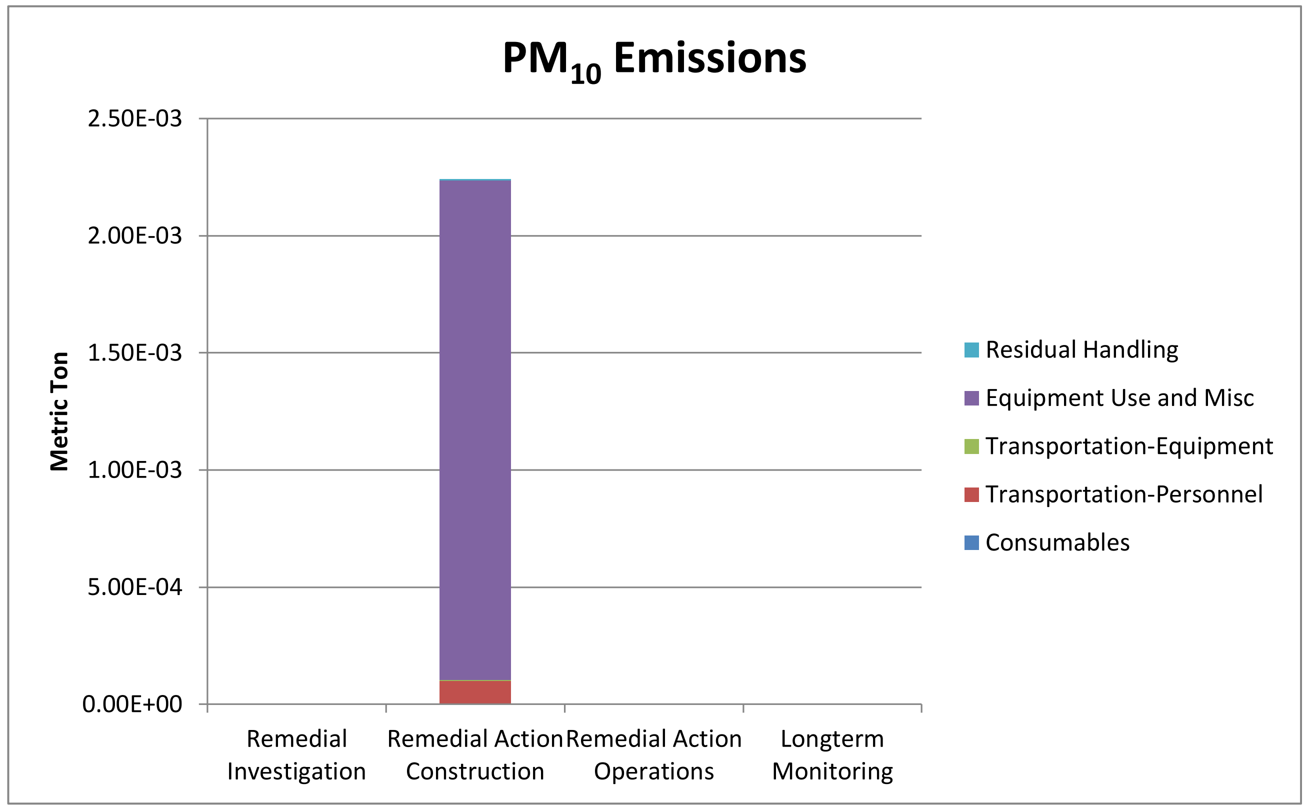

GHG Emissions
Metric Tons
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

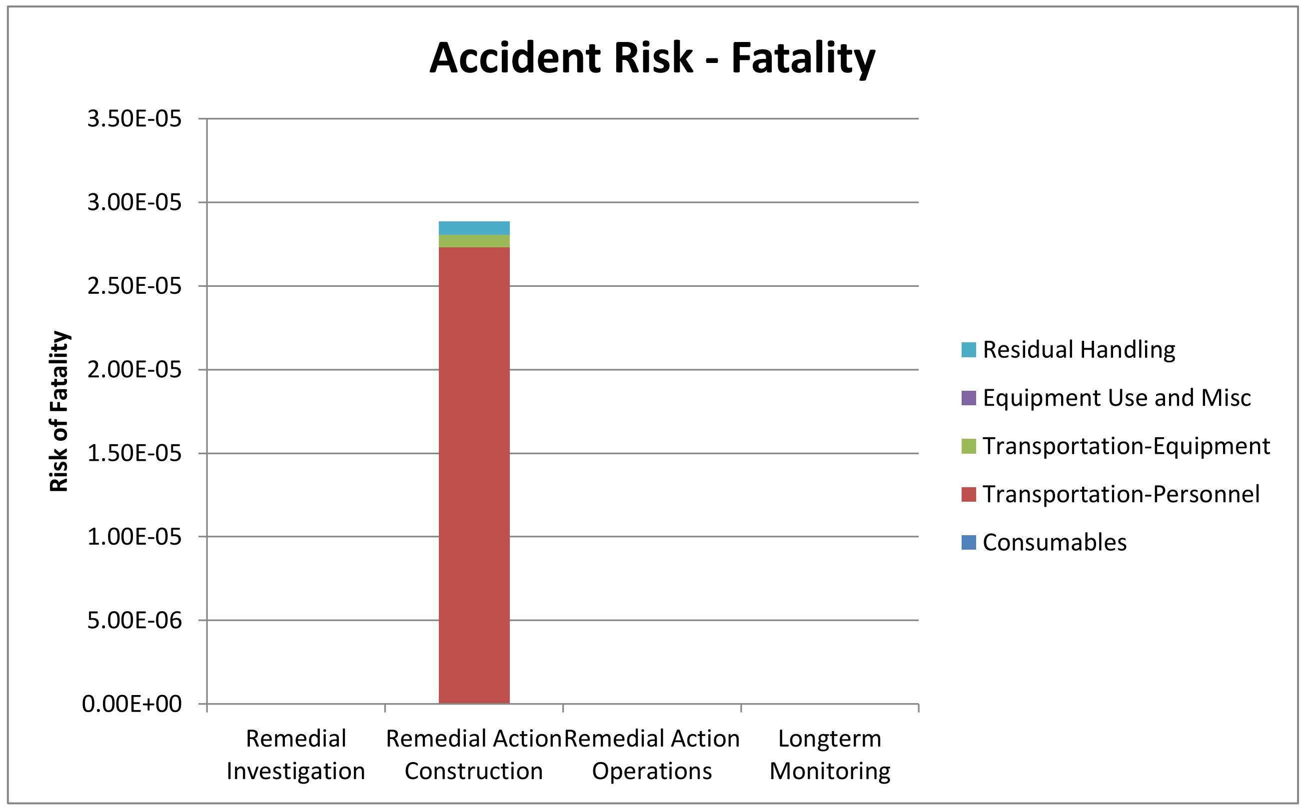

Total Energy Used
MMBTU
3.00E+02
2.50E+02
2.00E+02
1.50E+02
1.00E+02
5.00E+01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

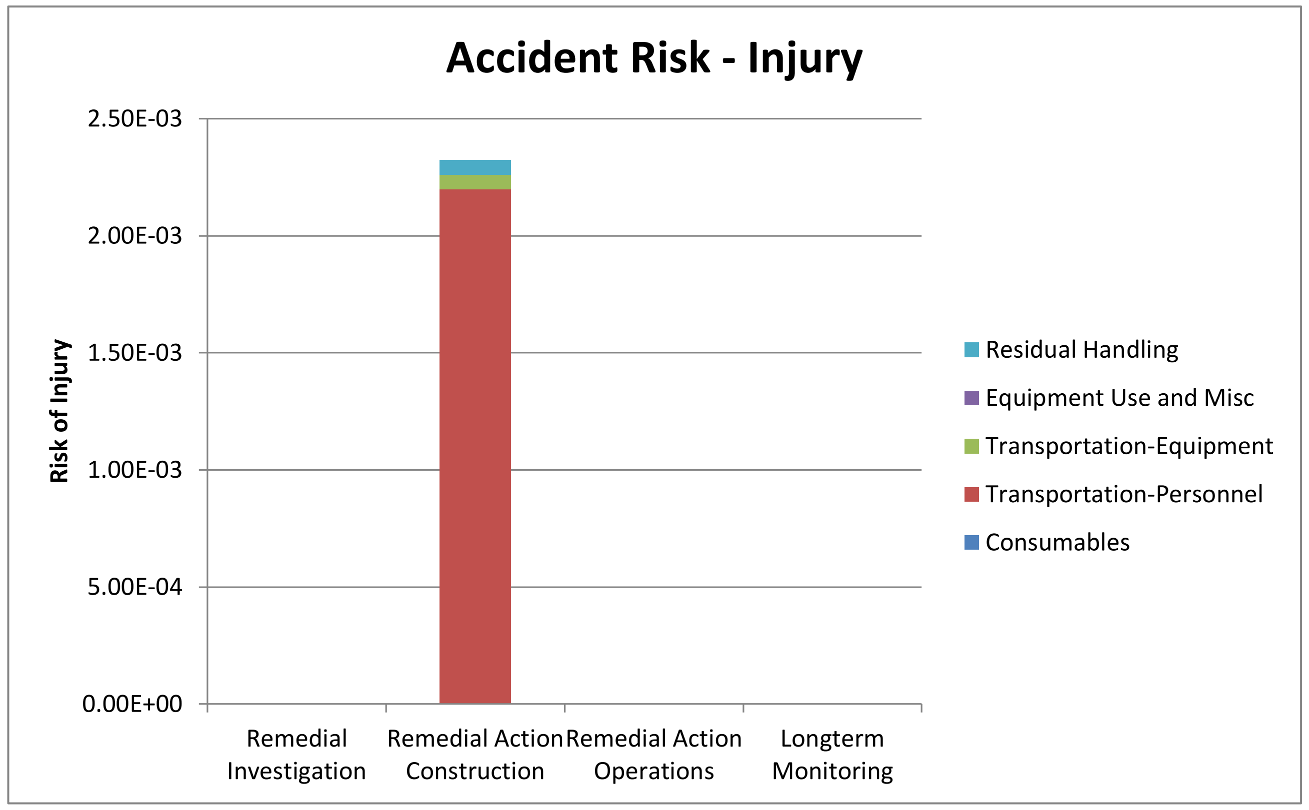

Water Consumption
Gallons
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.00E-02
1.80E-02
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.50E-05
3.00E-05
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

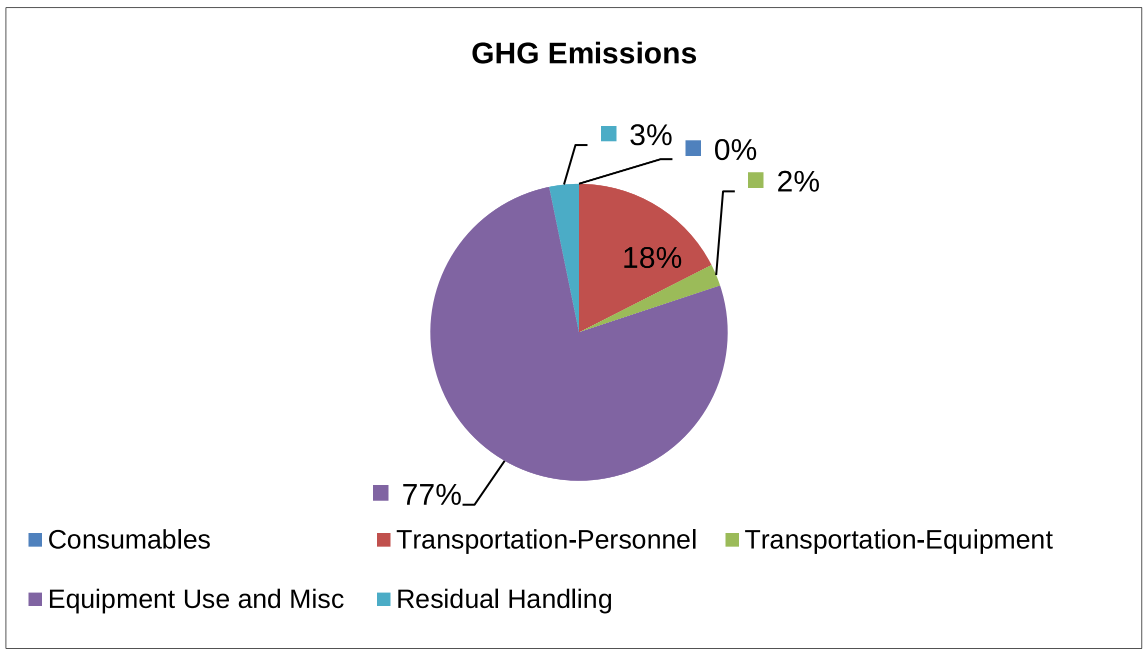

Accident Risk - Injury
Risk of Injury
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

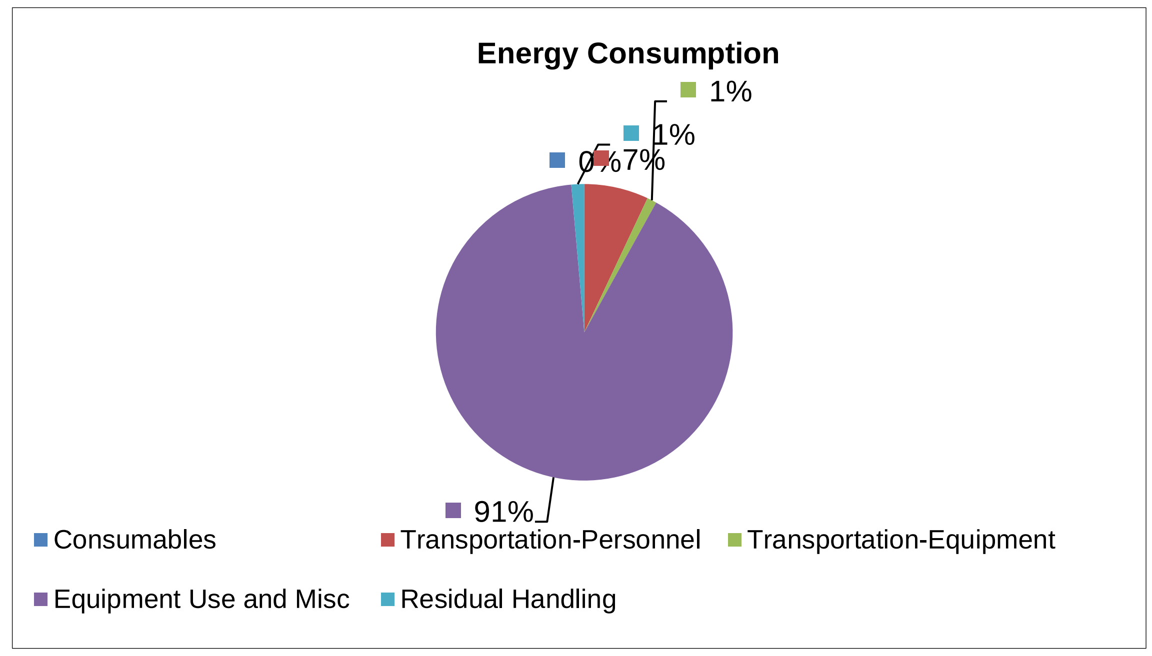
						Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	solvent wells	PVC	2 inch dia, PVC, 0.72 lbs/ft	900.00	lft	1.46	0.73	0.00	0.01	0.00	0.00	0.00	26.79	1.11
RAC	Equipment Decon Pad	HDPE	assume HDPE, 20ft X 20ft, 6 mm thick, 0.95 g/cm3	466.98	lbs	1.04	0.55	0.00	0.00	0.00	0.00	0.00	6.11	0.17
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 80 ft of timber, density for pine 530 kg/m3	1,471.00	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Monitoring Wells Head Compl	PVC	4 well heads, Assume PVC, 5 lb per head	20.00	lbs	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.83	0.03
	Subtotal					**2.56**	**1.32**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**33.75**	**1.33**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	4 wells, 80% utilization	128.00	hrs	2.05	2.00	0.00	0.00	0.02	0.00	0.00	15.64	
	Subtotal					**2.05**	**2.00**	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**	**15.64**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**5**	**3**	**0.00**	**0.02**	**0.02**	**0.01**	**0.00**	**49**	**1**

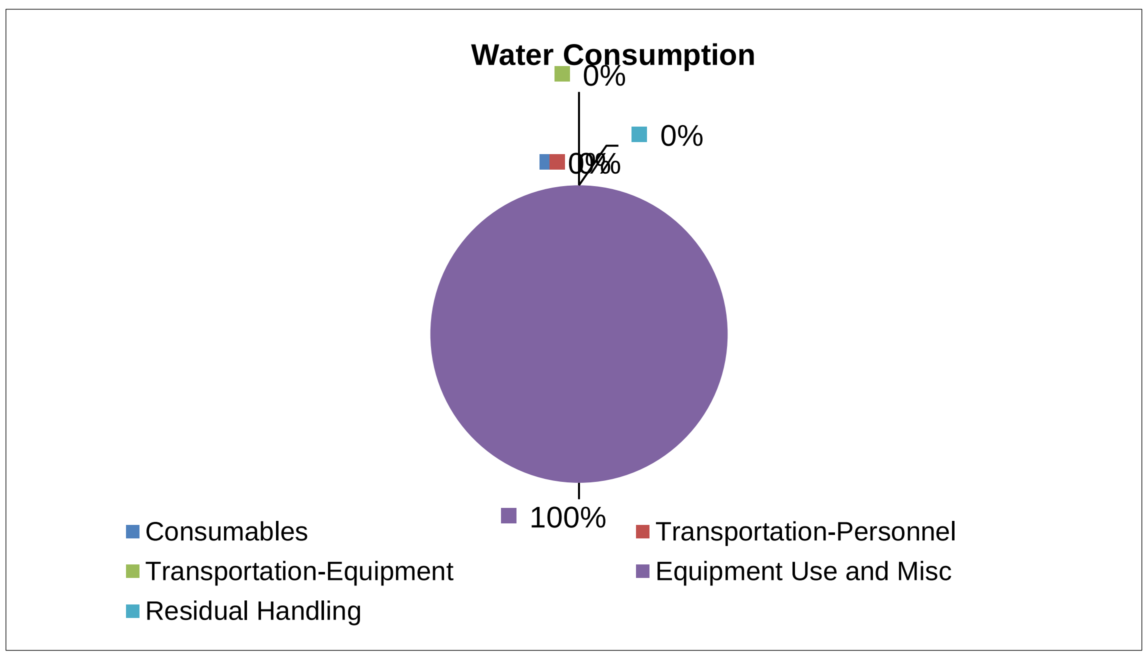
Alternative 1
Values Input into SiteWise as "Other"

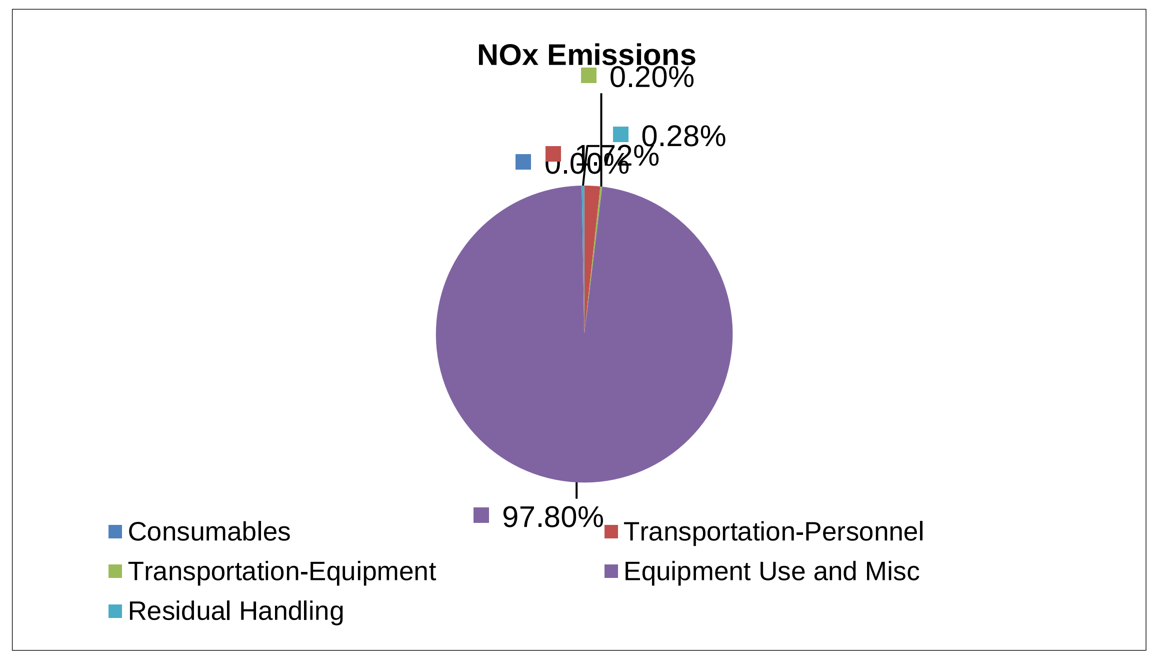
Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	4.61	3.33	0.97	0.32	0.02	0.01	0.00	168.52	1,326.53
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

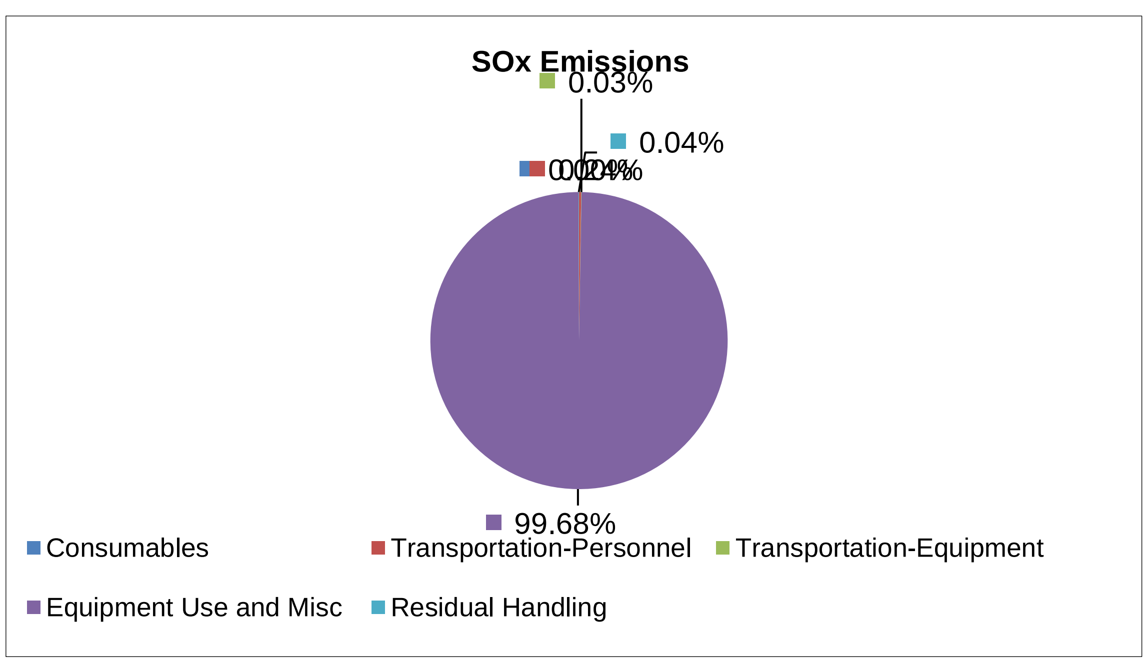
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

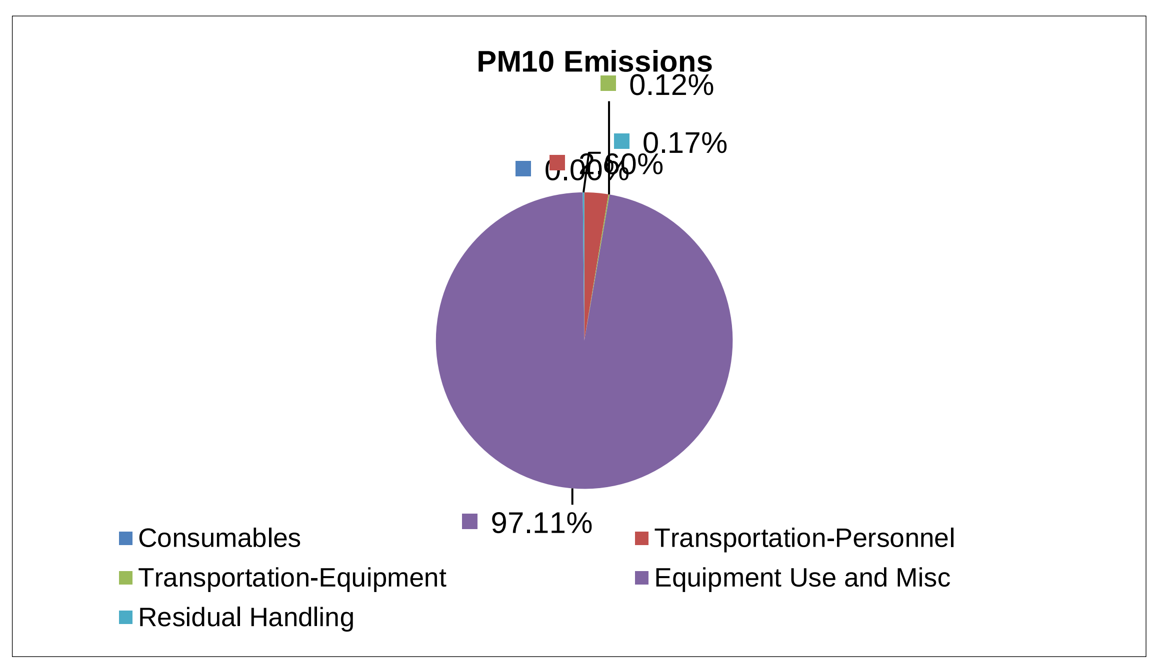

GHG Emissions
3%
0%
2%
18%
77%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

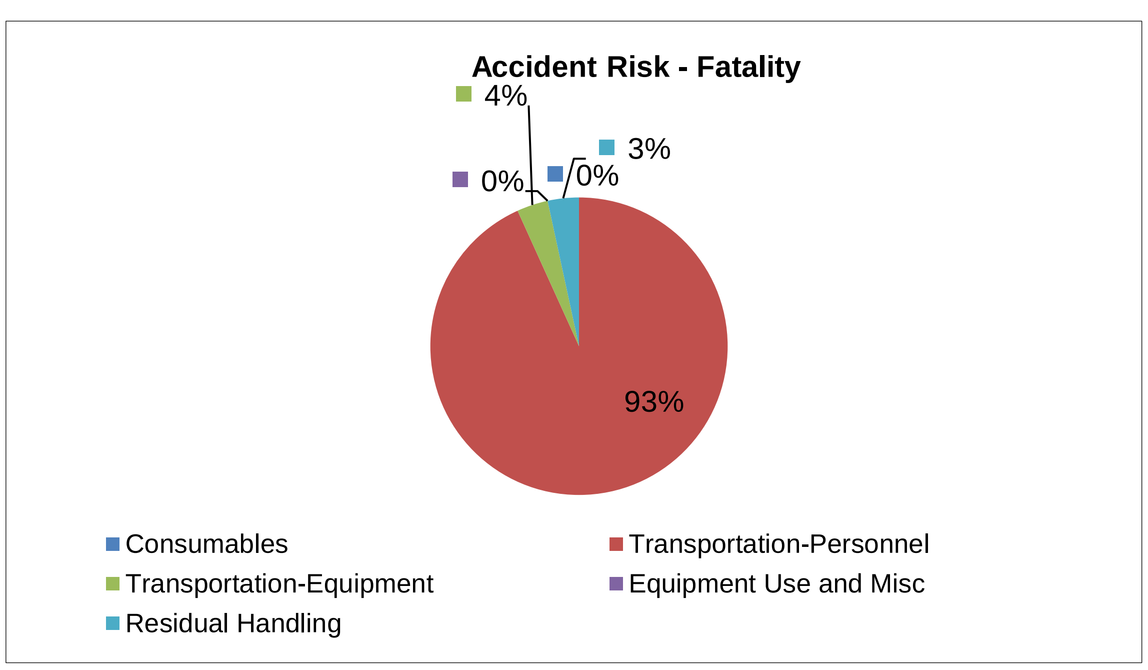

Energy Consumption
1%
1%
91%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

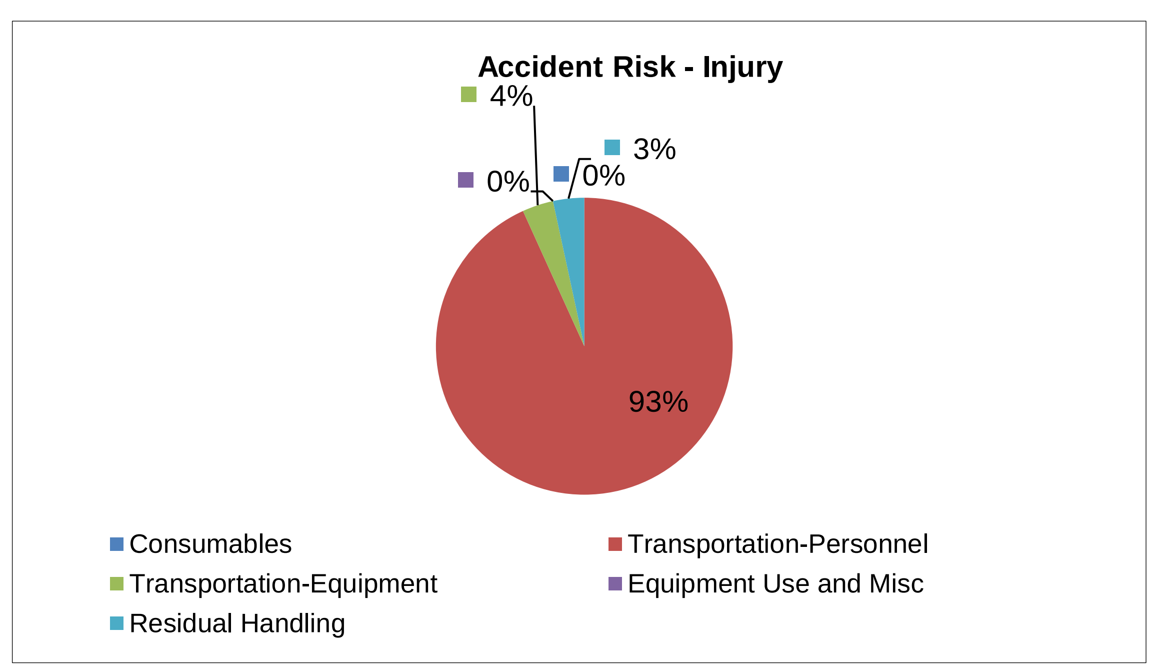

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.20%
0.28%
97.80%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.03%
0.04%
99.68%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.12%
0.17%
97.11%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
4%
0%
3%
0%
93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

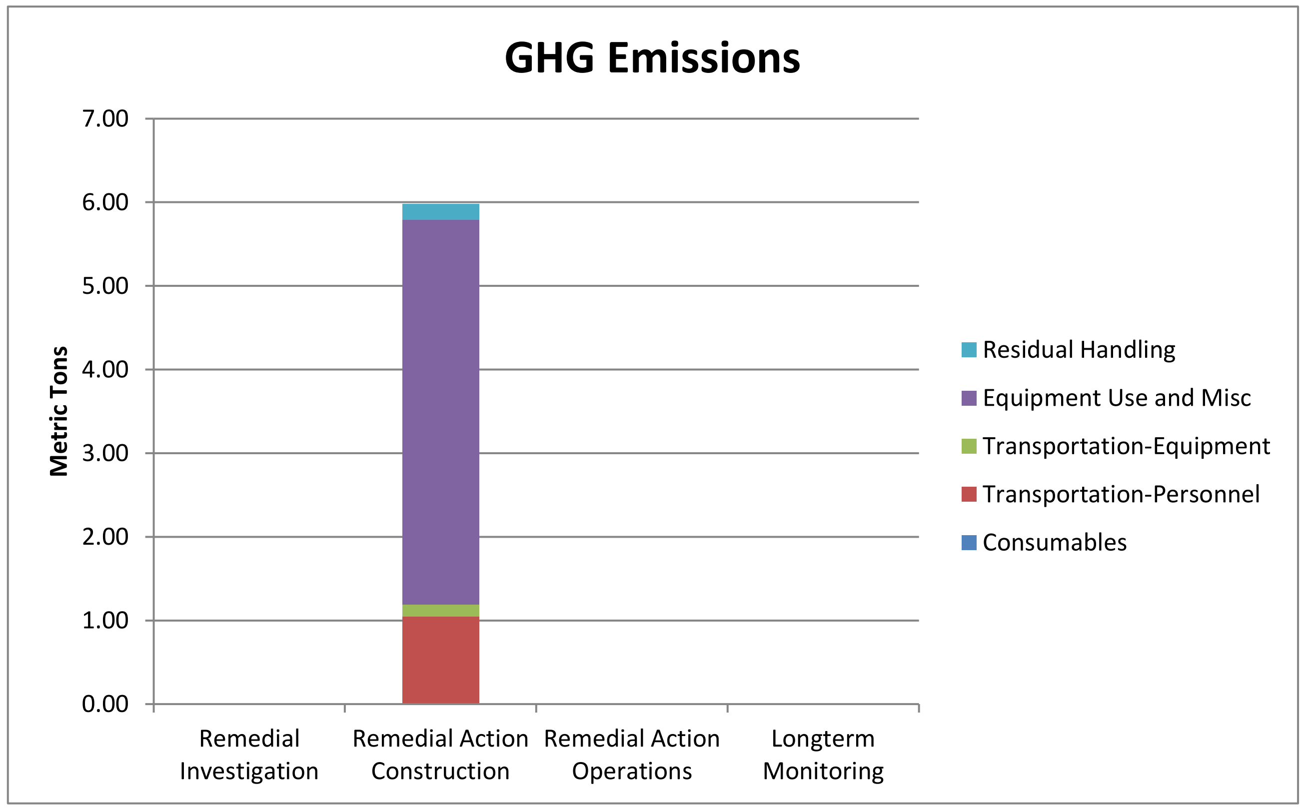

Accident Risk - Injury
4%
0%
3%
0%
93%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

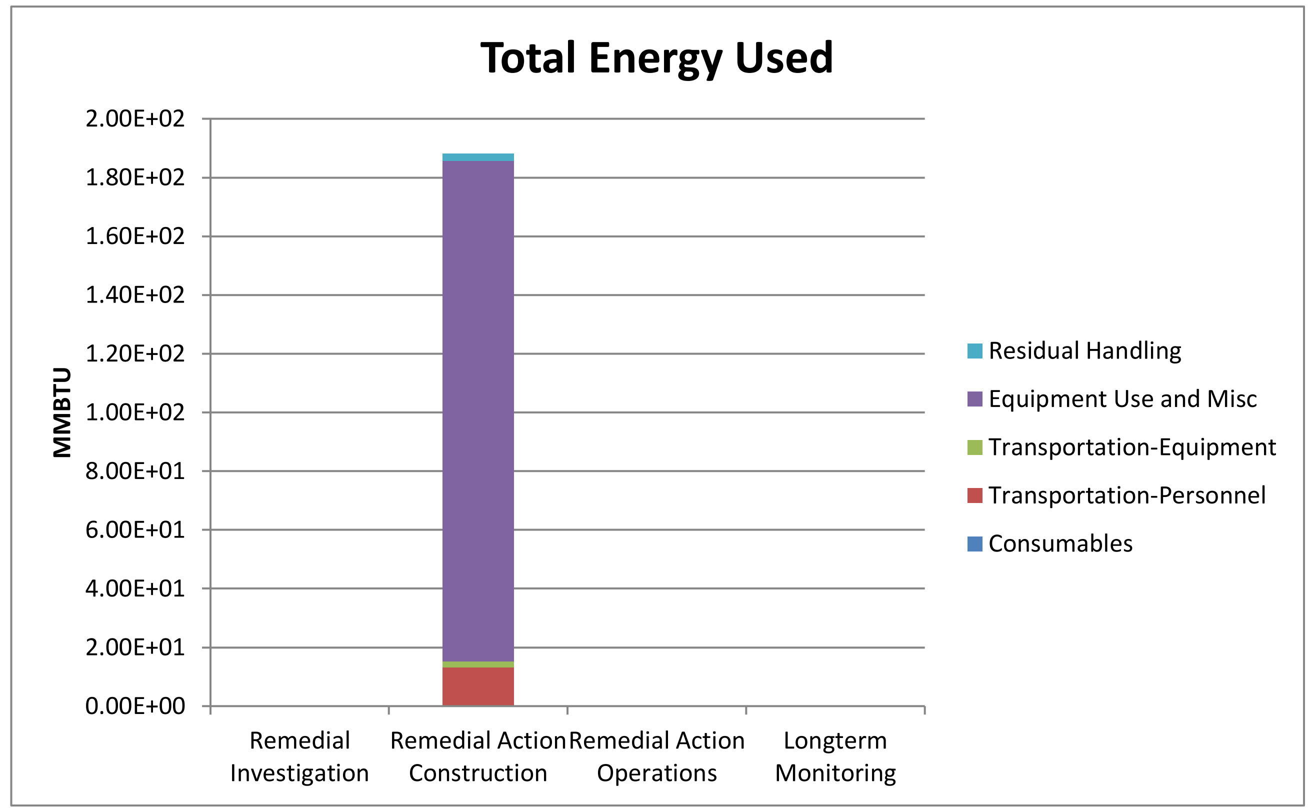
Sustainable Remediation - Environmental Footprint Summary

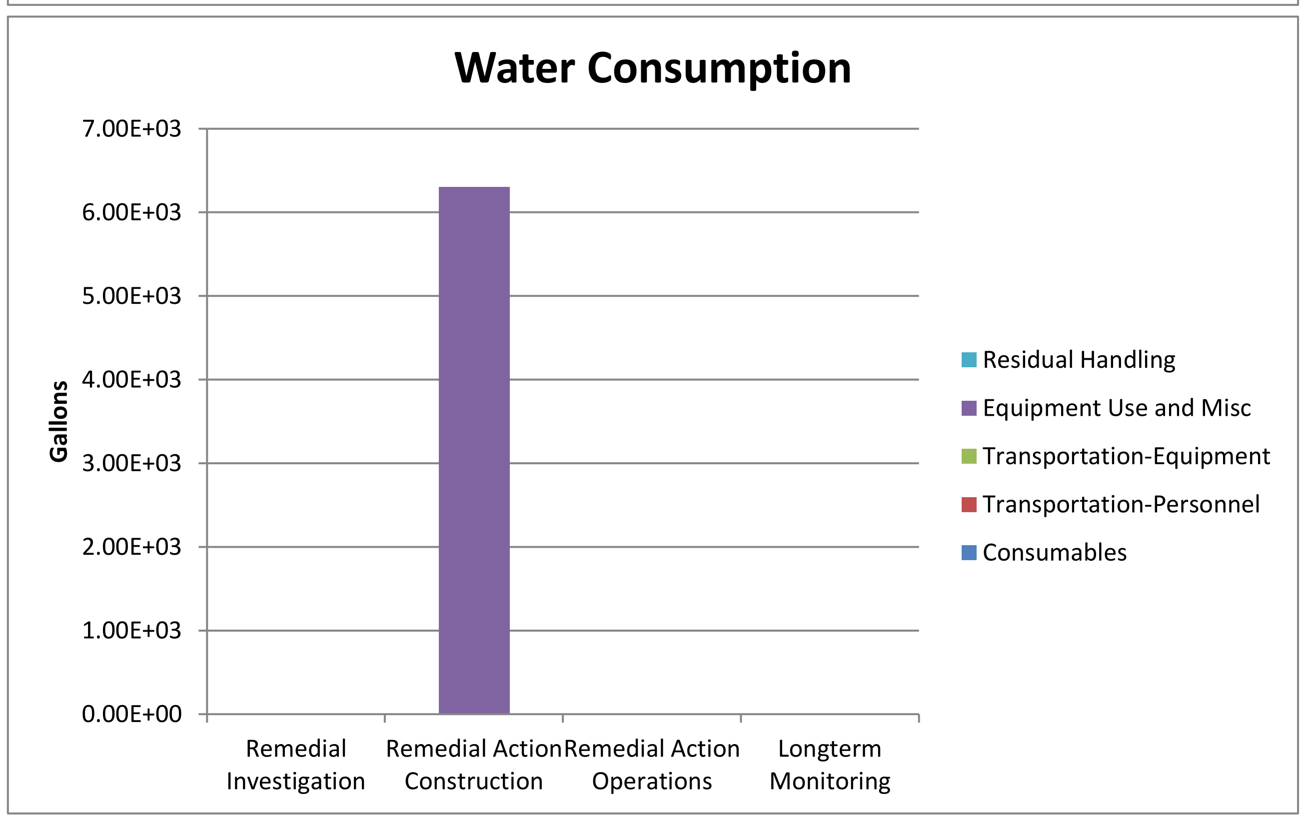
Phase	Activities	GHG Emissions metric ton	Total energy Used MMBTU	Water Consumption gallons	NOx emissions metric ton	SOx Emissions metric ton	PM10 Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.05	1.3E+01	NA	3.9E-04	1.4E-05	7.9E-05	2.1E-05	1.7E-03
	Transportation-Equipment	0.14	2.0E+00	NA	4.6E-05	1.9E-06	3.7E-06	7.8E-07	6.3E-05
	Equipment Use and Misc	4.60	1.7E+02	6.3E+03	2.2E-02	5.7E-03	2.9E-03	0.0E+00	0.0E+00
	Residual Handling	0.19	2.6E+00	NA	6.2E-05	2.5E-06	5.0E-06	7.8E-07	6.3E-05
	Sub-Total	5.98	1.88E+02	6.30E+03	2.25E-02	5.73E-03	3.02E-03	2.30E-05	1.85E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**6.0E+00**	**1.9E+02**	**6.3E+03**	**2.3E-02**	**5.7E-03**	**3.0E-03**	**2.3E-05**	**1.9E-03**

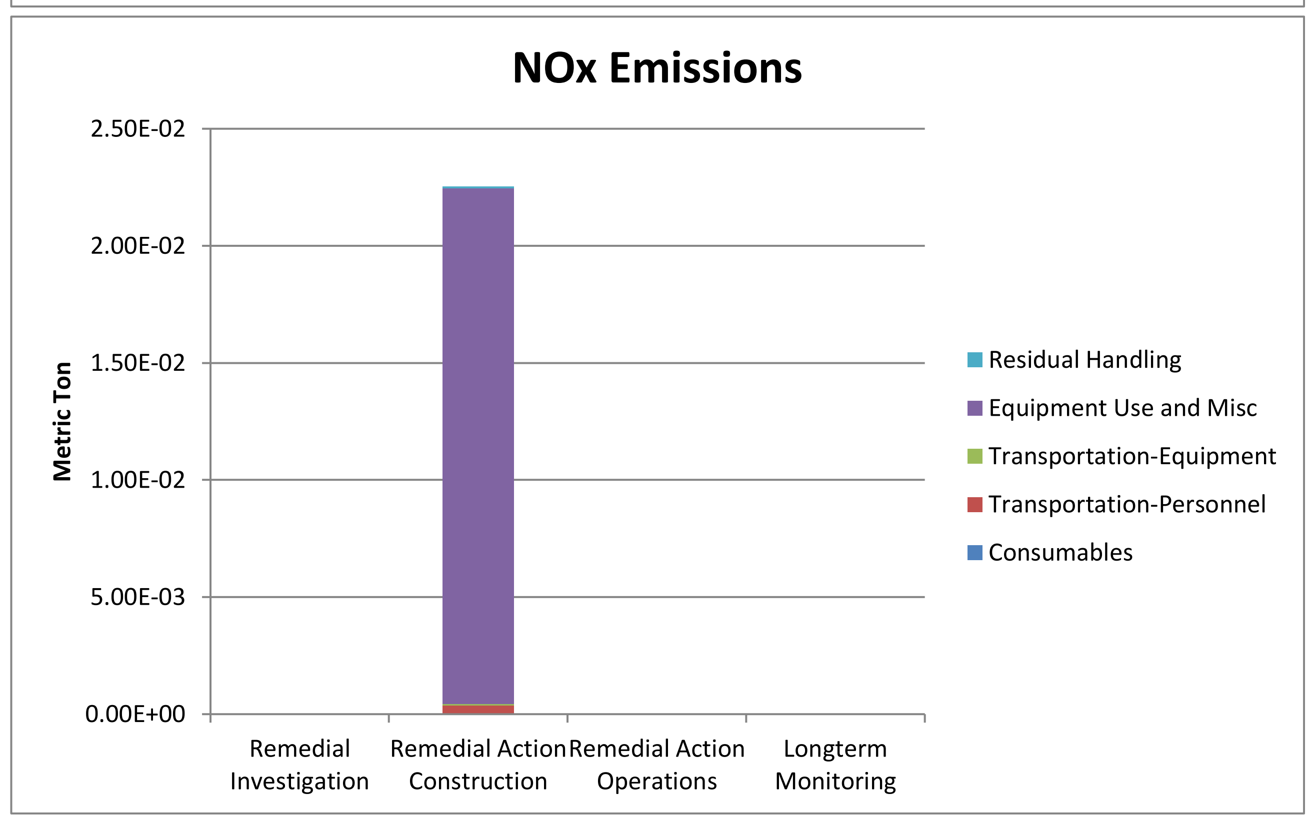
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space tons	Hazardous Waste Landfill Space tons	Topsoil Consumption cubic yards	Costing $	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	1.5E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**1.5E-02**

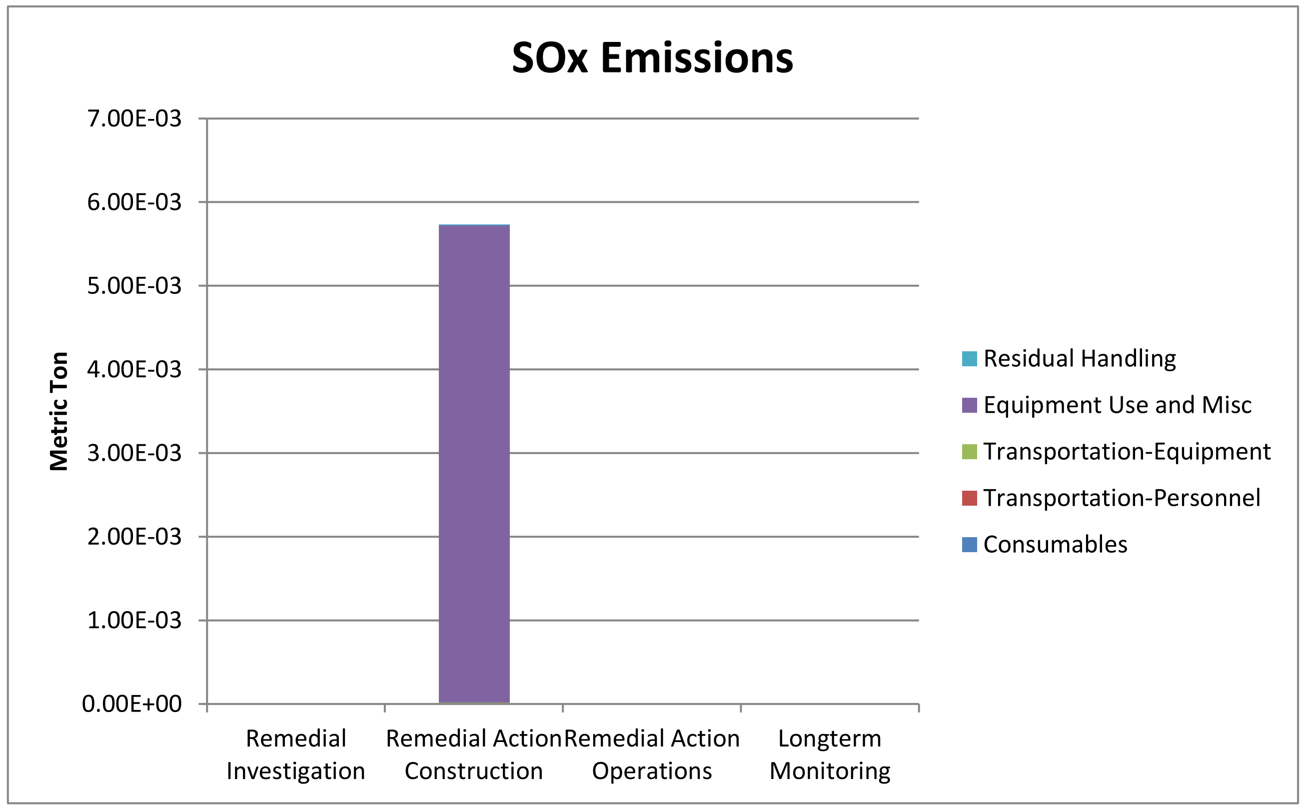
Total Cost with Footprint Reduction
$0

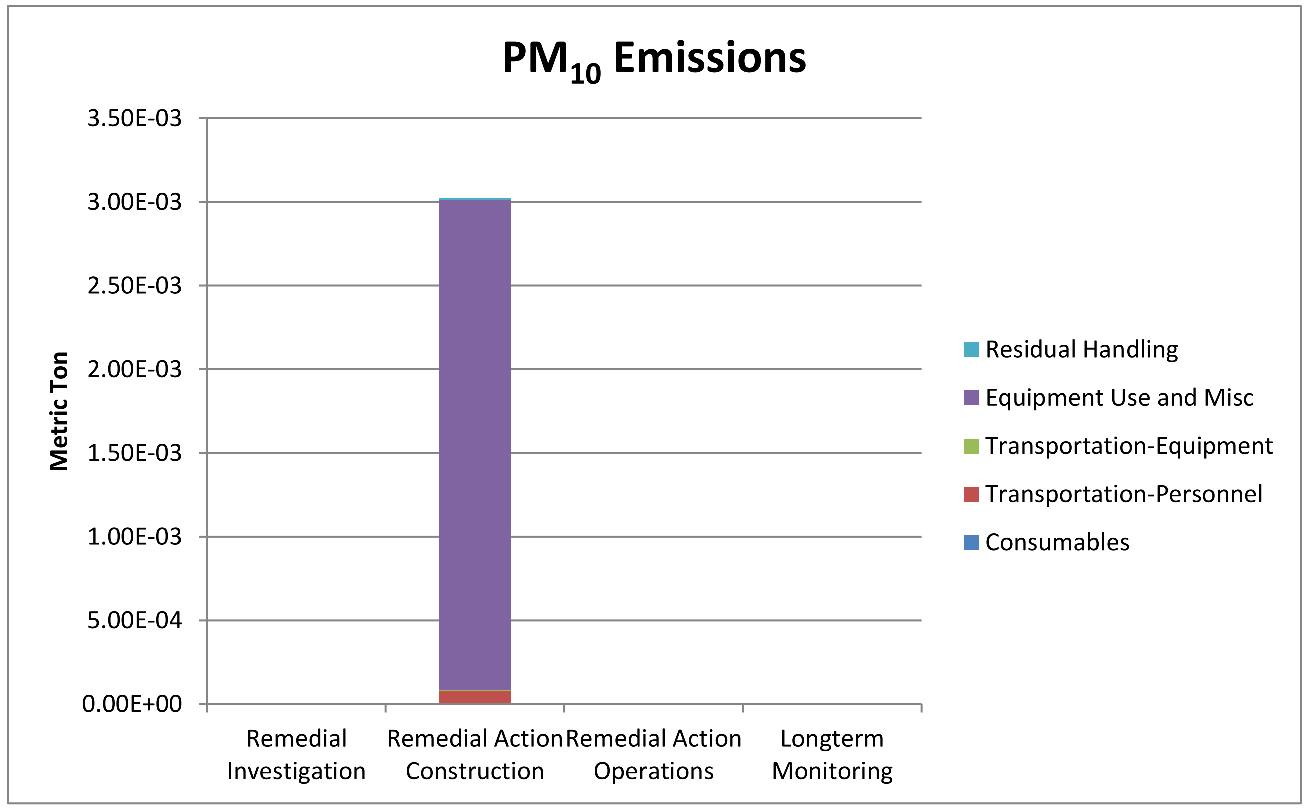

GHG Emissions
Metric Tons
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

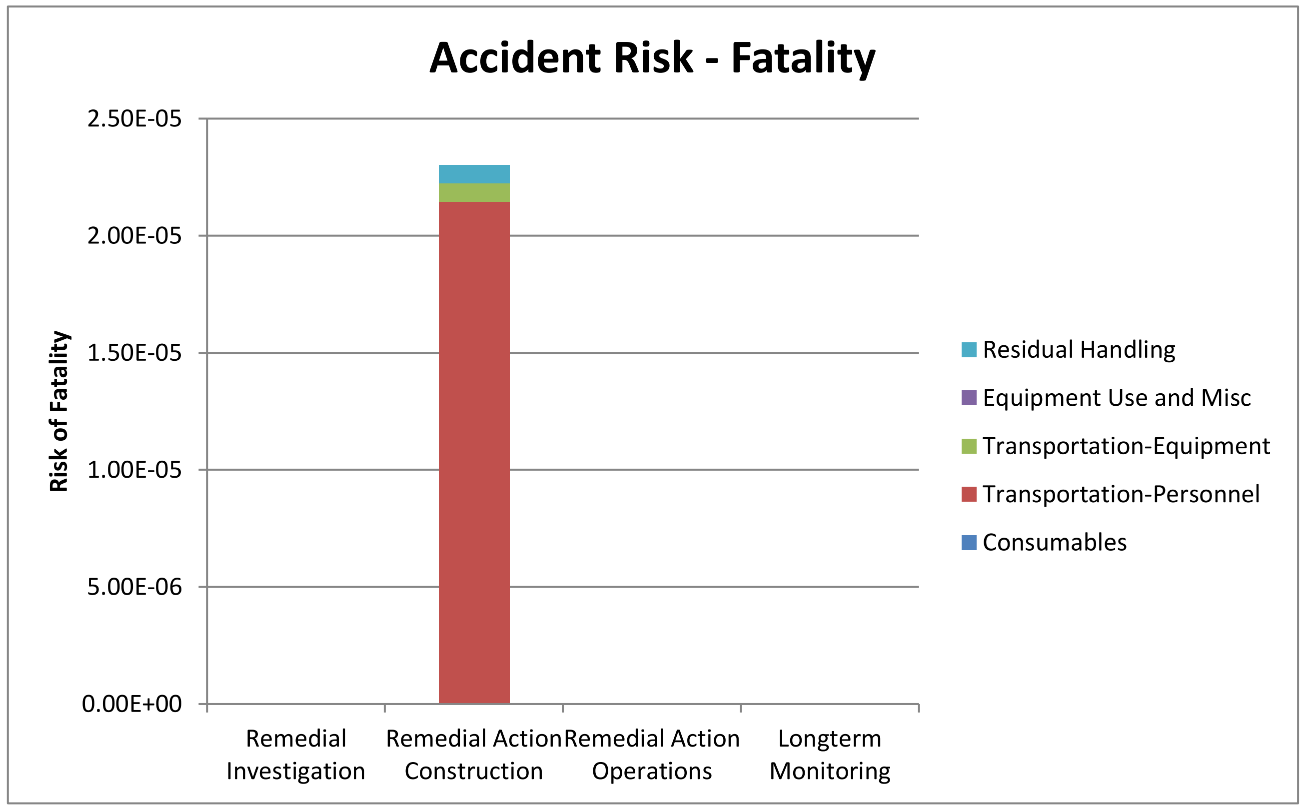

Total Energy Used
MMBTU
2.00E+02
1.80E+02
1.60E+02
1.40E+02
1.20E+02
1.00E+02
8.00E+01
6.00E+01
4.00E+01
2.00E+01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

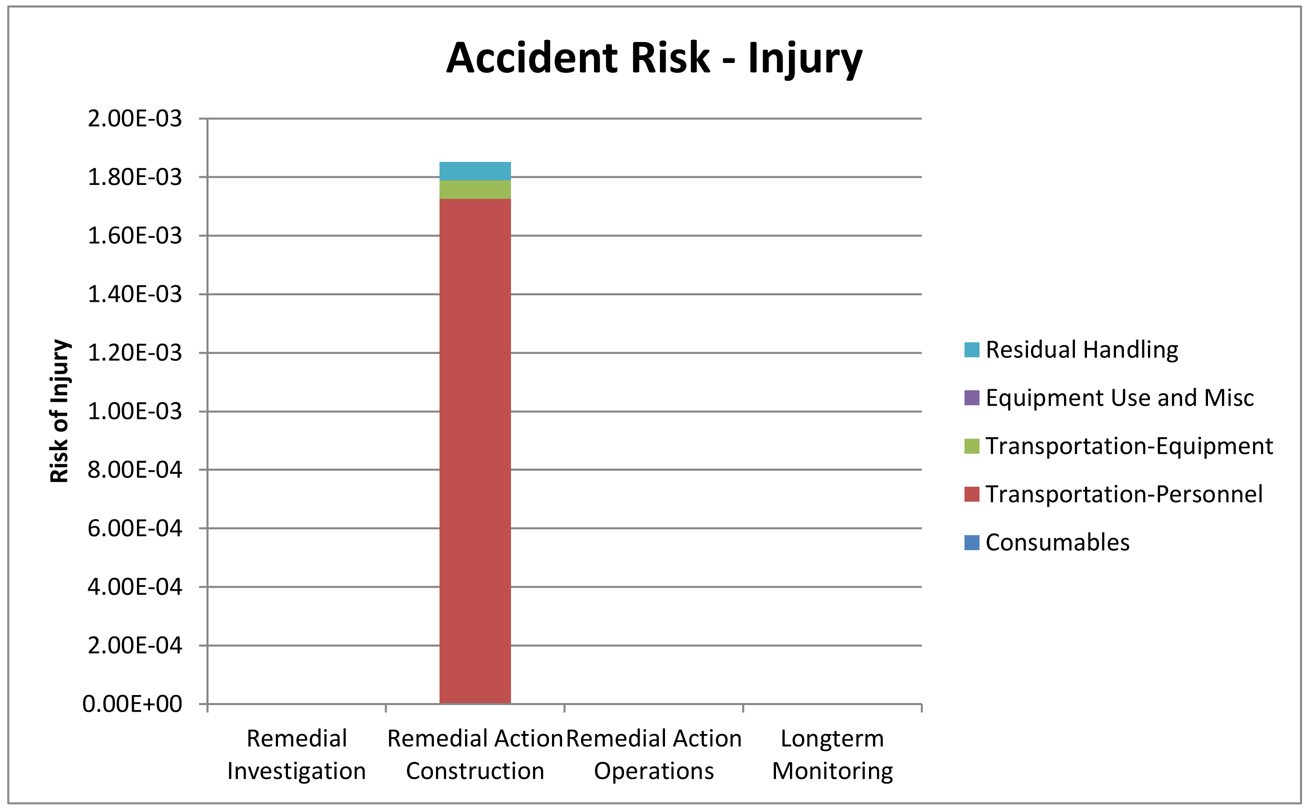

Water Consumption
Gallons
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
7.00E-03
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM$_{10}$ Emissions
Metric Ton
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

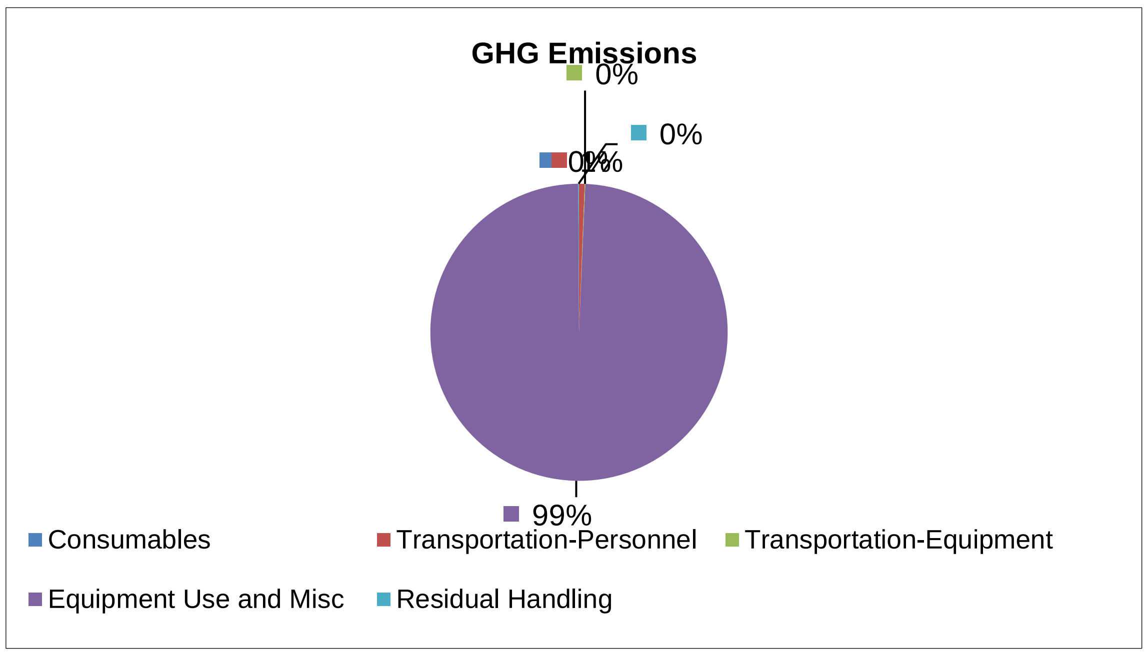

Accident Risk - Injury
Risk of Injury
2.00E-03
1.80E-03
1.60E-03
1.40E-03
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

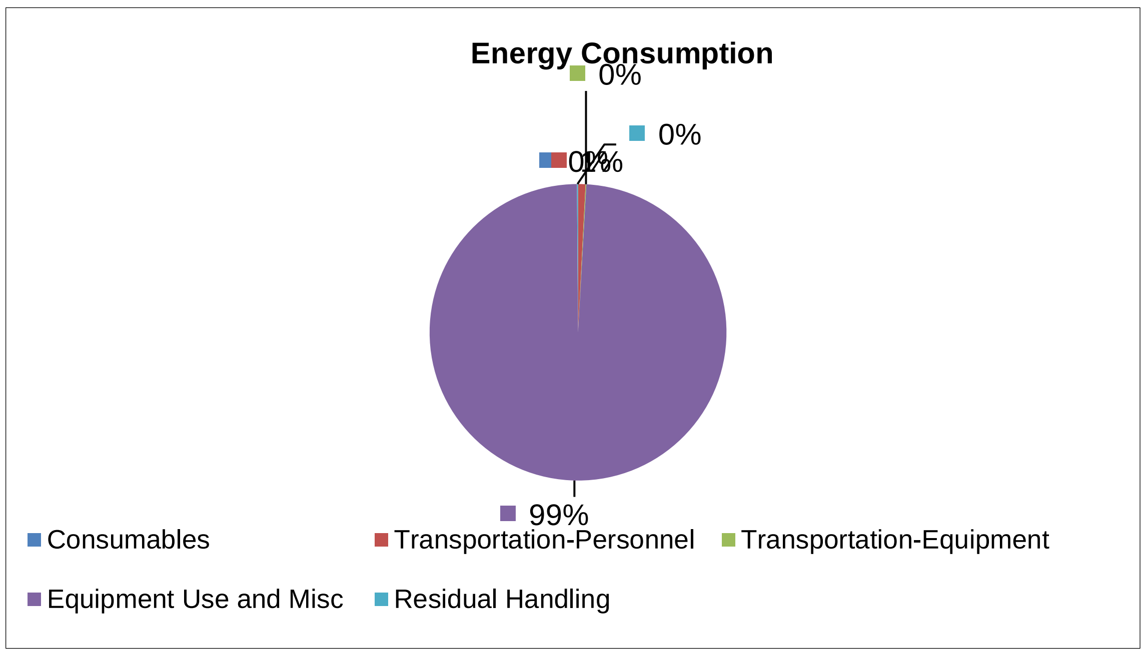
	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	**Materials**							**Tonnes**					**MWhr**	**gal x 1000**
RAC	solvent wells	PVC	2 inch dia, PVC, 0.72 lbs/ft	900.00	lft	1.46	0.73	0.00	0.01	0.00	0.00	0.00	26.79	1.11
RAC	Equipment Decon Pad	HDPE	assume HDPE, 20ft X 20ft, 6 mm thick, 0.95 g/cm3	466.98	lbs	1.04	0.55	0.00	0.00	0.00	0.00	0.00	6.11	0.17
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 80 ft of timber, density for pine 530 kg/m3	1,471.00	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	GAC	GAC	liquid phase GAC, 8 5,000 pound units	40,000.00	lbs	229.48	117.01	0.36	0.00	1.09	0.11	0.00	608.26	15.82
RAC	Monitoring Wells Head Compl	PVC	4 well heads, Assume PVC, 5 lb per head	20.00	lbs	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.83	0.03
	Subtotal					**232.04**	**118.33**	**0.37**	**0.01**	**1.09**	**0.11**	**0.00**	**642.01**	**17.14**
	Construction Equipment							**Tonnes**					**MWhr**	**gal x 1000**
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	4 wells, 80% utilization	128.00	hrs	2.05	2.00	0.00	0.00	0.02	0.00	0.00	15.64	
	Subtotal					**2.05**	**2.00**	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**	**15.64**	**0**
	Operating Consumption						**Tonnes**						**MWhr**	**gal x 1000**
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**234**	**120**	**0.37**	**0.02**	**1.11**	**0.11**	**0.00**	**658**	**17**

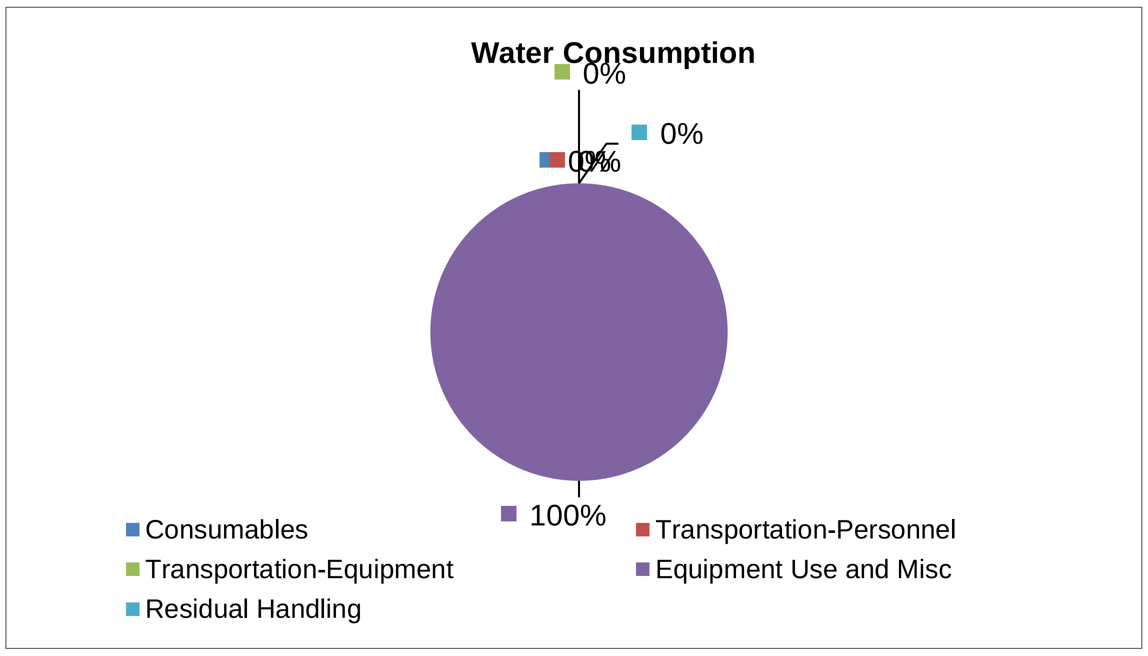
Alternative 1
Values Input into SiteWise as "Other"

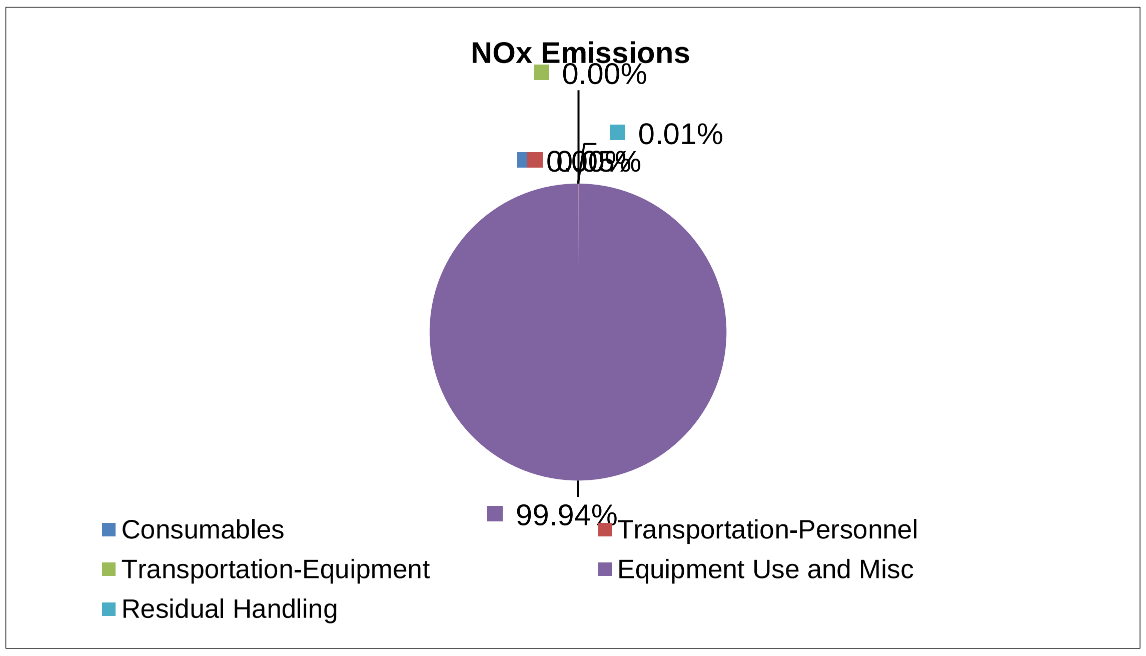
Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	234.09	120.33	113.44	0.32	1.11	0.11	0.00	2,243.92	17,142.64
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

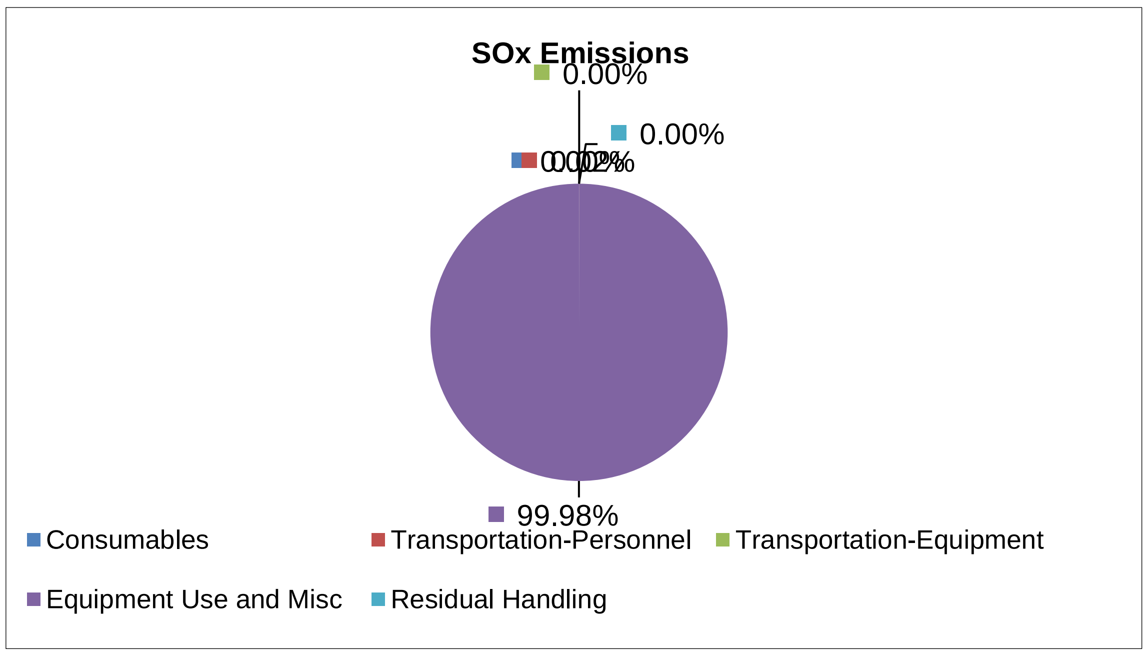
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

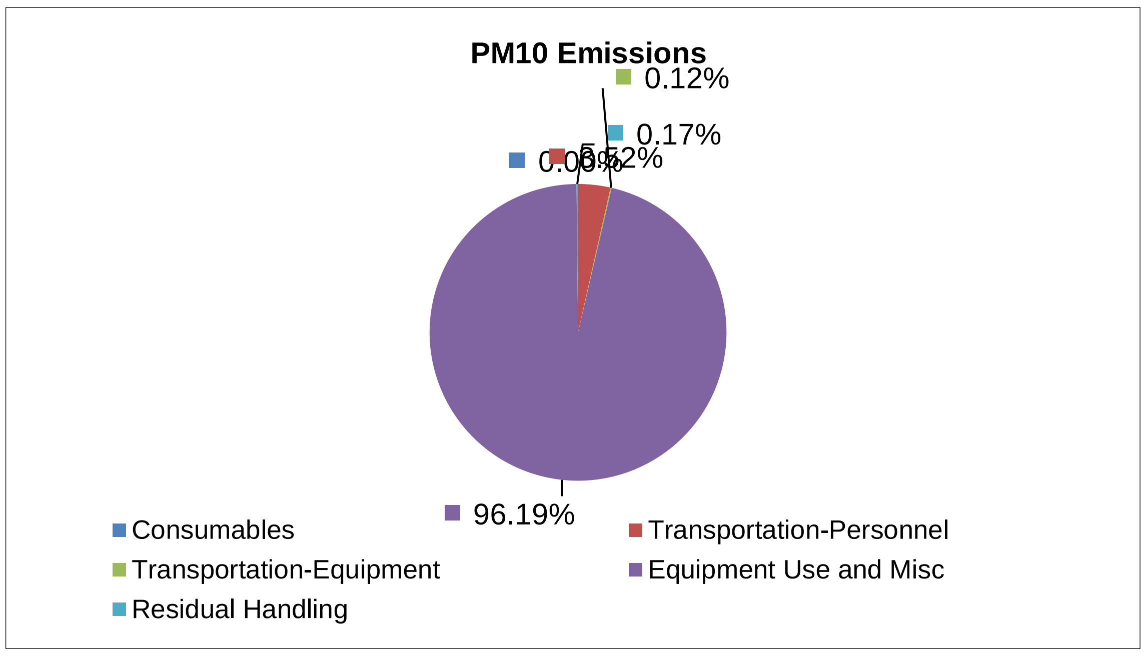

GHG Emissions
0%
0%
0%
1%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

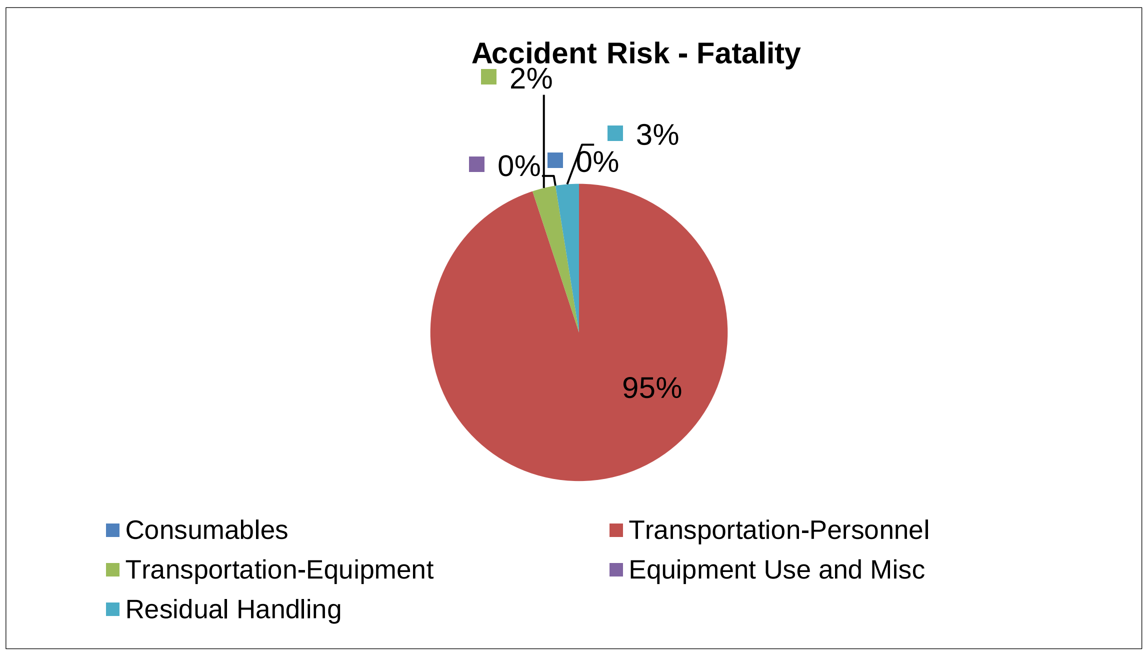

Energy Consumption
0%
0%
0%
1%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

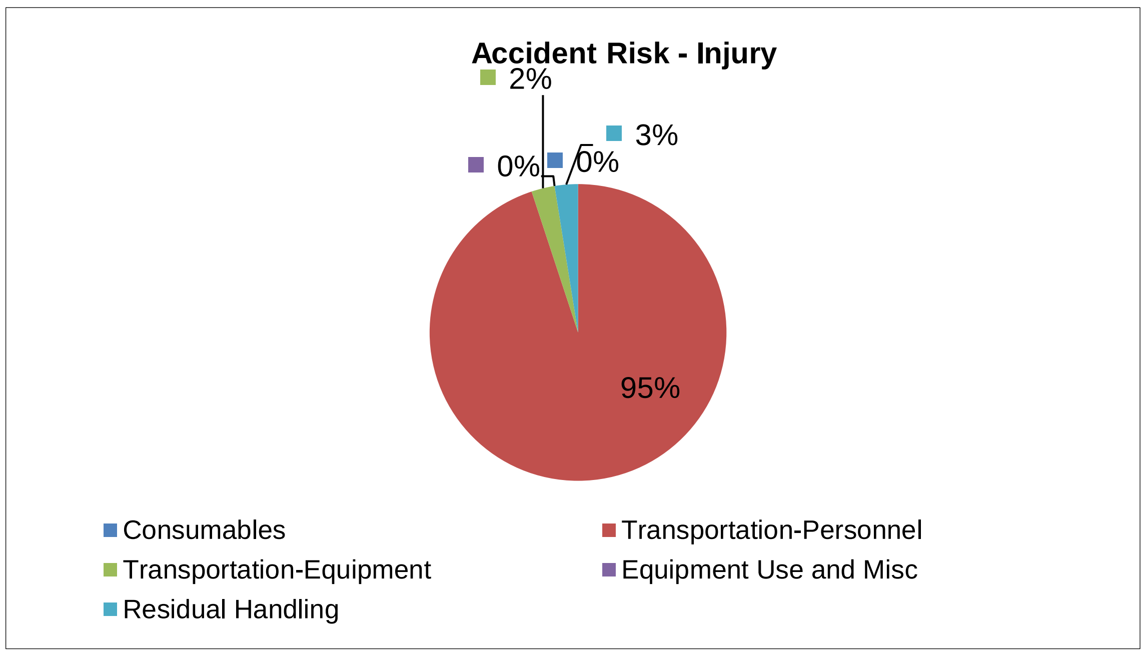

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.00%
0.01%
99.94%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.00%
0.00%
99.98%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.12%
0.17%
96.19%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
2%
3%
0%
0%
95%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

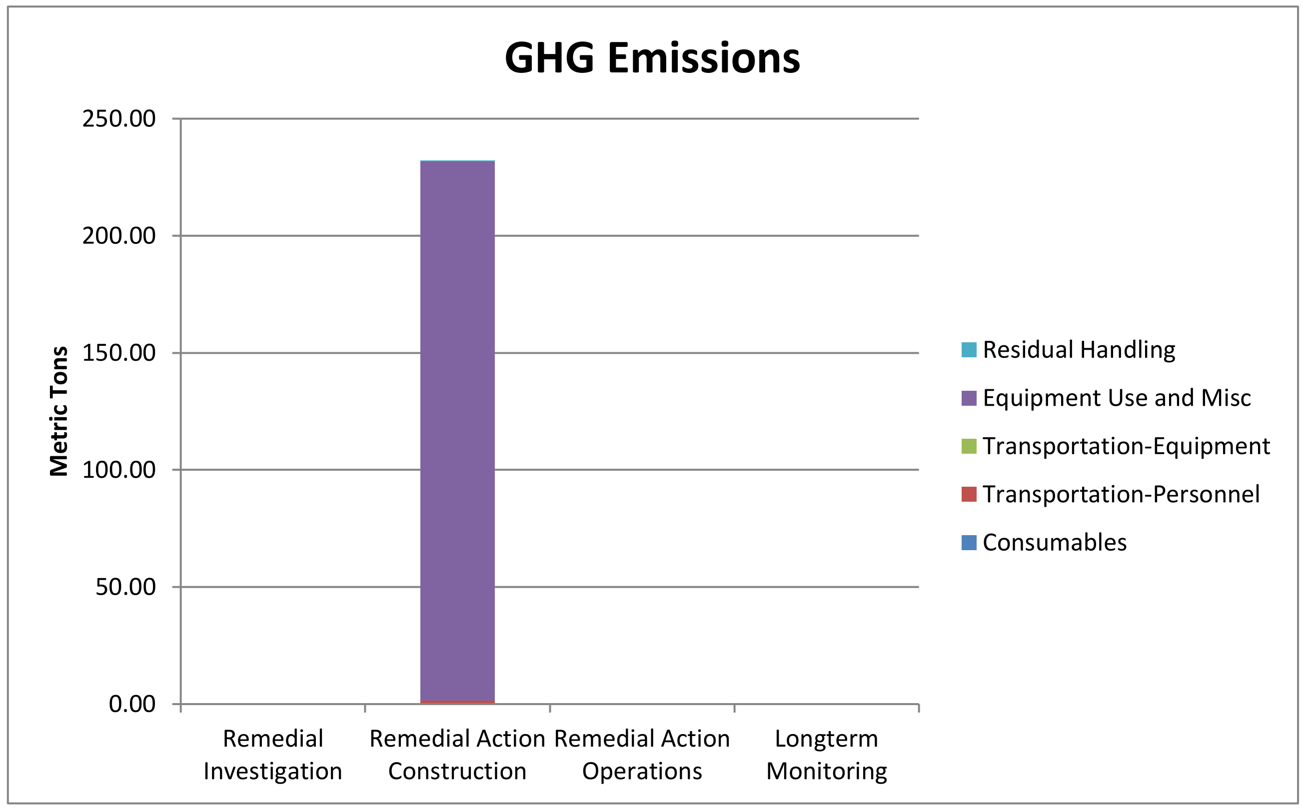

Accident Risk - Injury
2%
3%
0%
0%
95%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

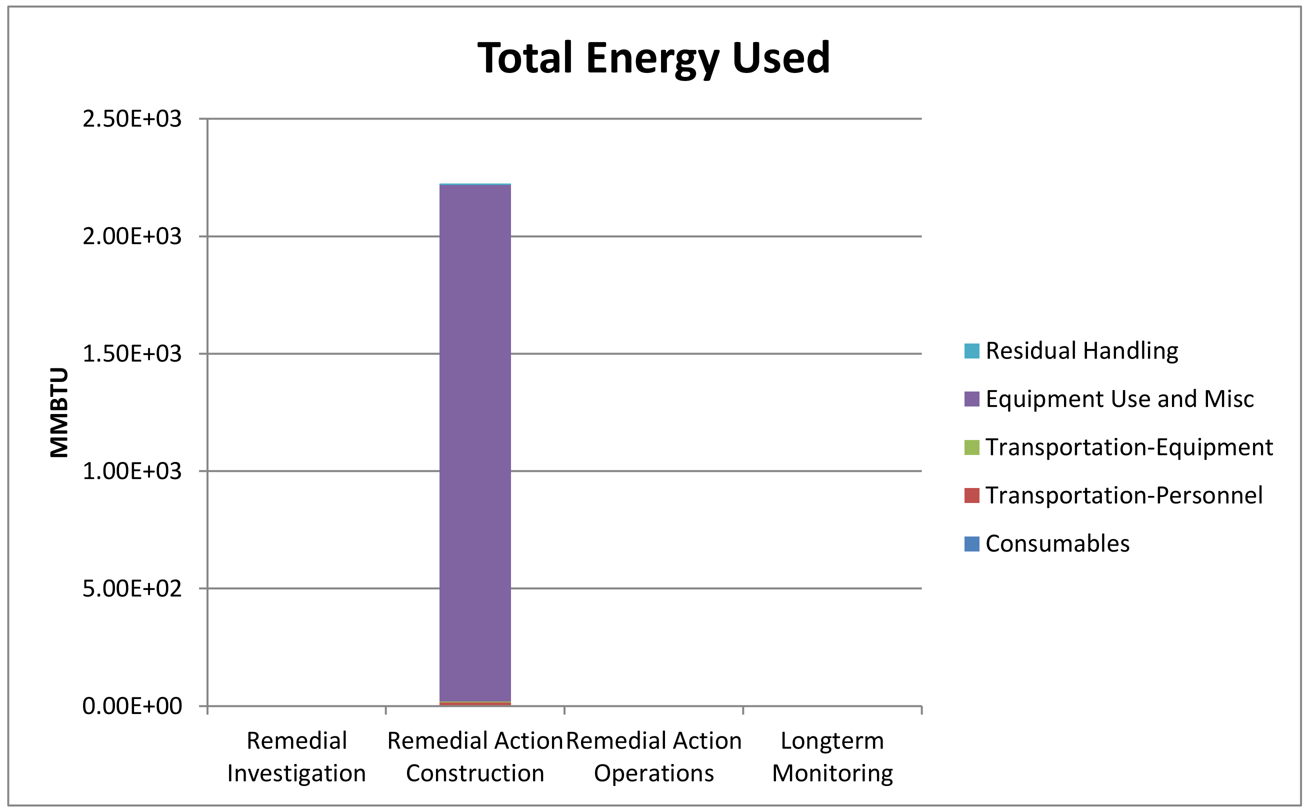
Sustainable Remediation - Environmental Footprint Summary

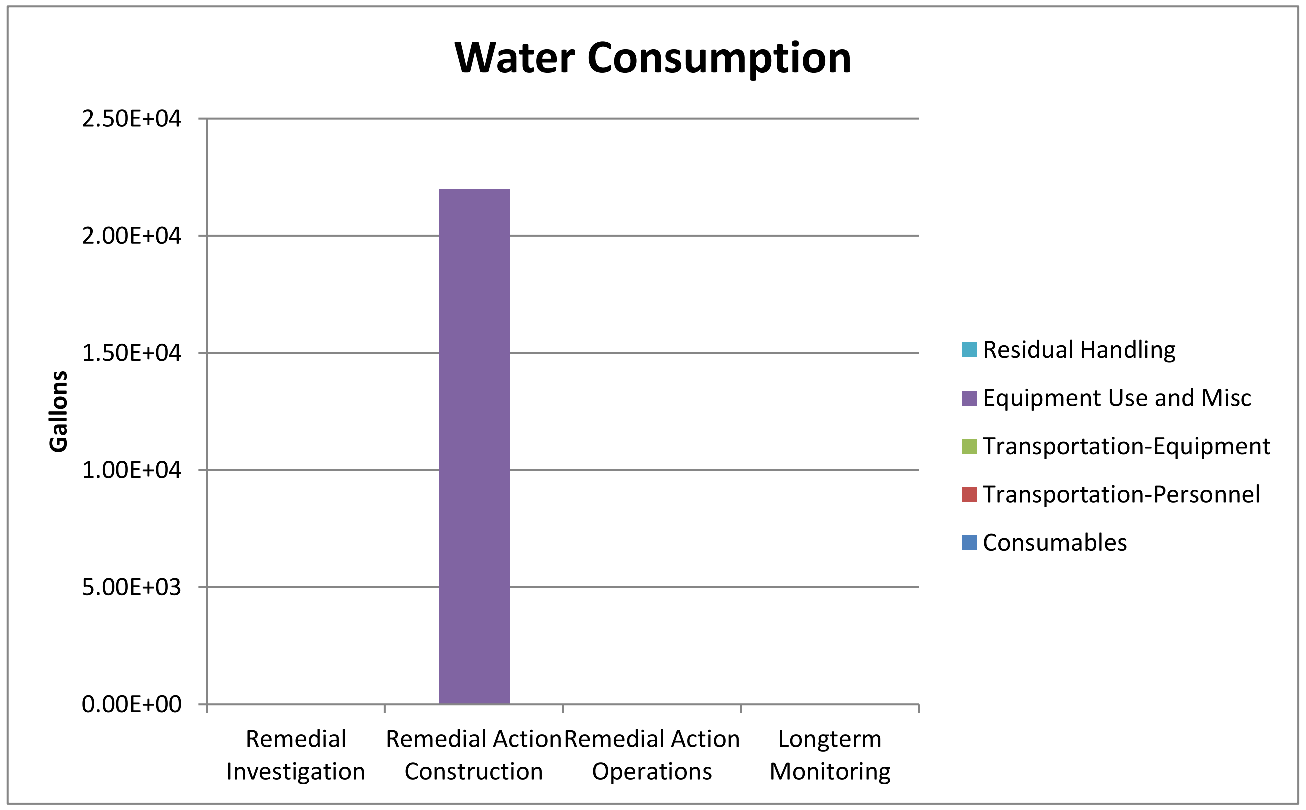
Phase	Activities	GHG Emissions metric ton	Total energy Used MMBTU	Water Consumption gallons	NOx emissions metric ton	SOx Emissions metric ton	PM10 Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.43	1.8E+01	NA	5.3E-04	1.9E-05	1.1E-04	2.9E-05	2.4E-03
	Transportation-Equipment	0.14	2.0E+00	NA	4.6E-05	1.9E-06	3.7E-06	7.8E-07	6.3E-05
	Equipment Use and Misc	230.33	2.2E+03	2.2E+04	1.1E+00	1.1E-01	2.9E-03	0.0E+00	0.0E+00
	Residual Handling	0.19	2.6E+00	NA	6.2E-05	2.5E-06	5.0E-06	7.8E-07	6.3E-05
	Sub-Total	232.10	2.22E+03	2.20E+04	1.10E+00	1.10E-01	3.05E-03	3.08E-05	2.48E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**2.3E+02**	**2.2E+03**	**2.2E+04**	**1.1E+00**	**1.1E-01**	**3.0E-03**	**3.1E-05**	**2.5E-03**

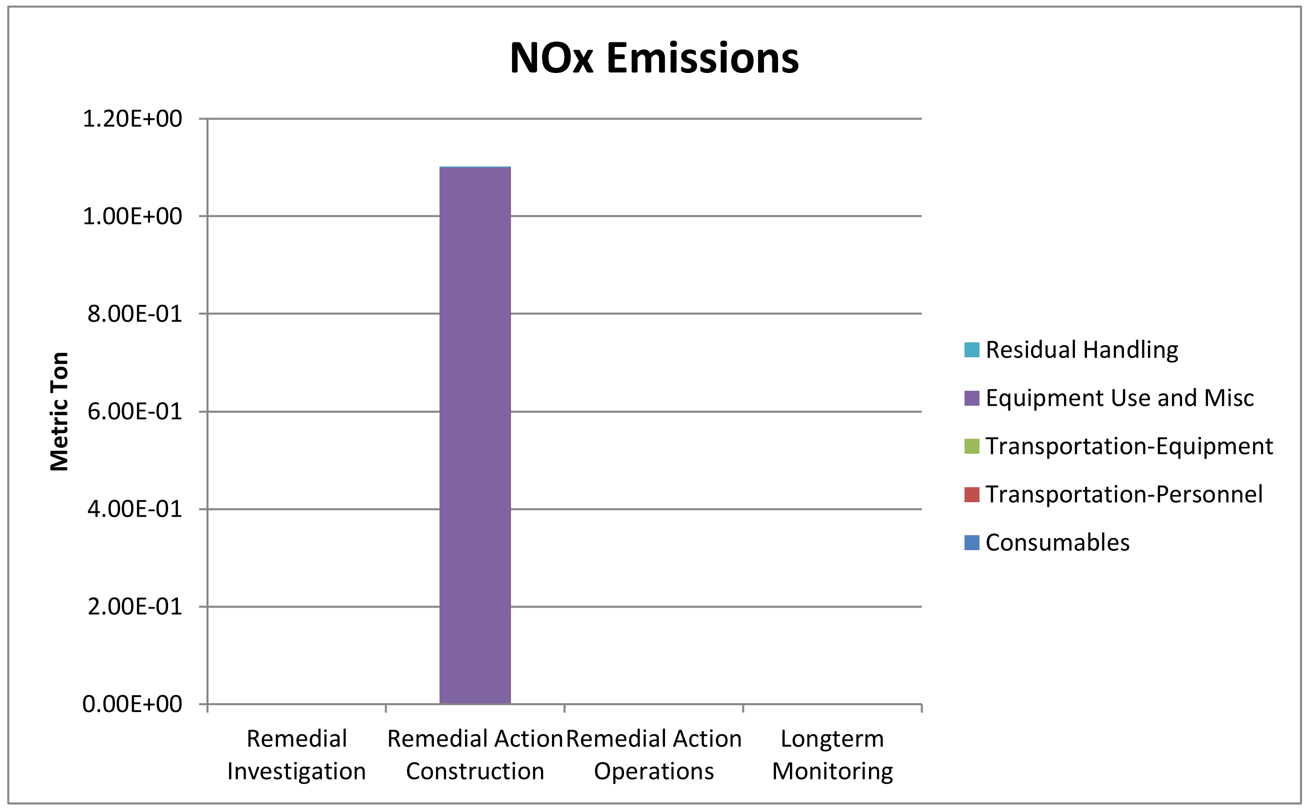
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space tons	Hazardous Waste Landfill Space tons	Topsoil Consumption cubic yards	Costing $	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	2.0E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**2.0E-02**

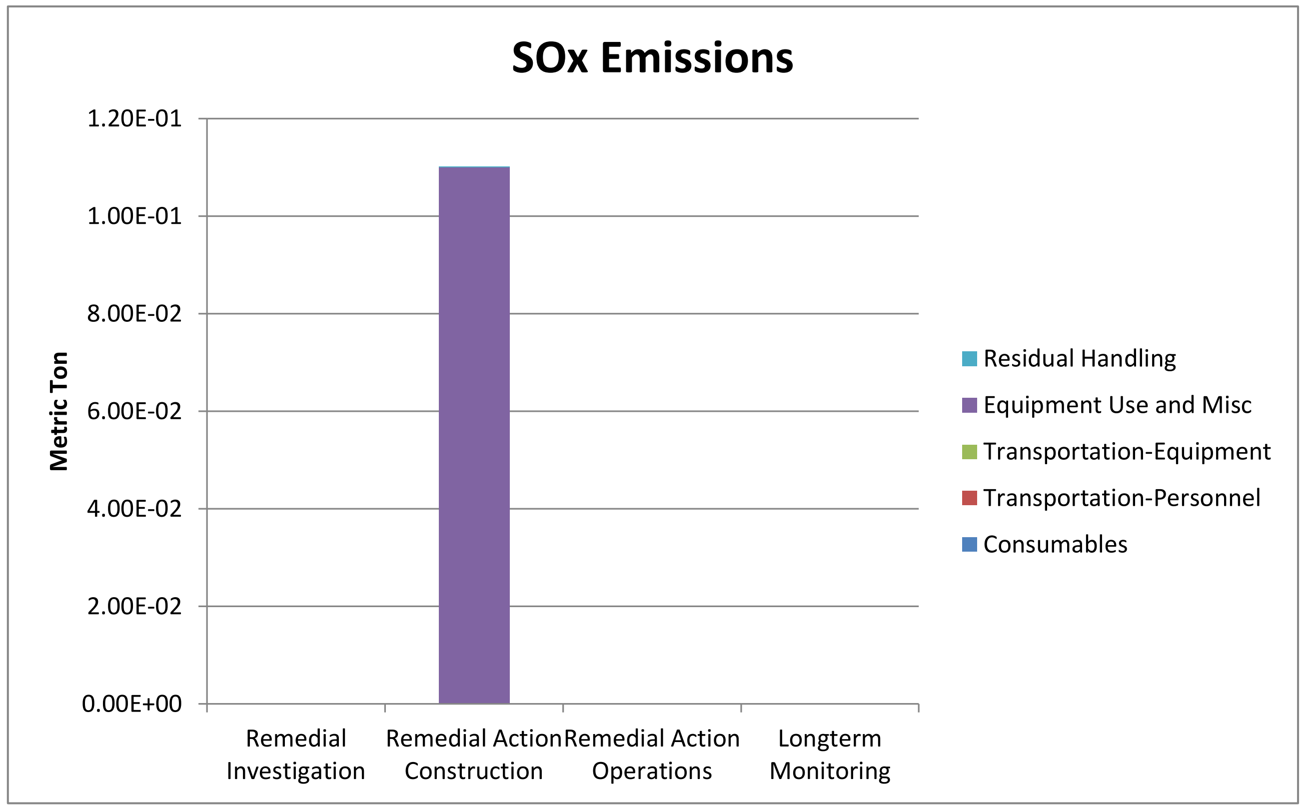
Total Cost with Footprint Reduction
$0

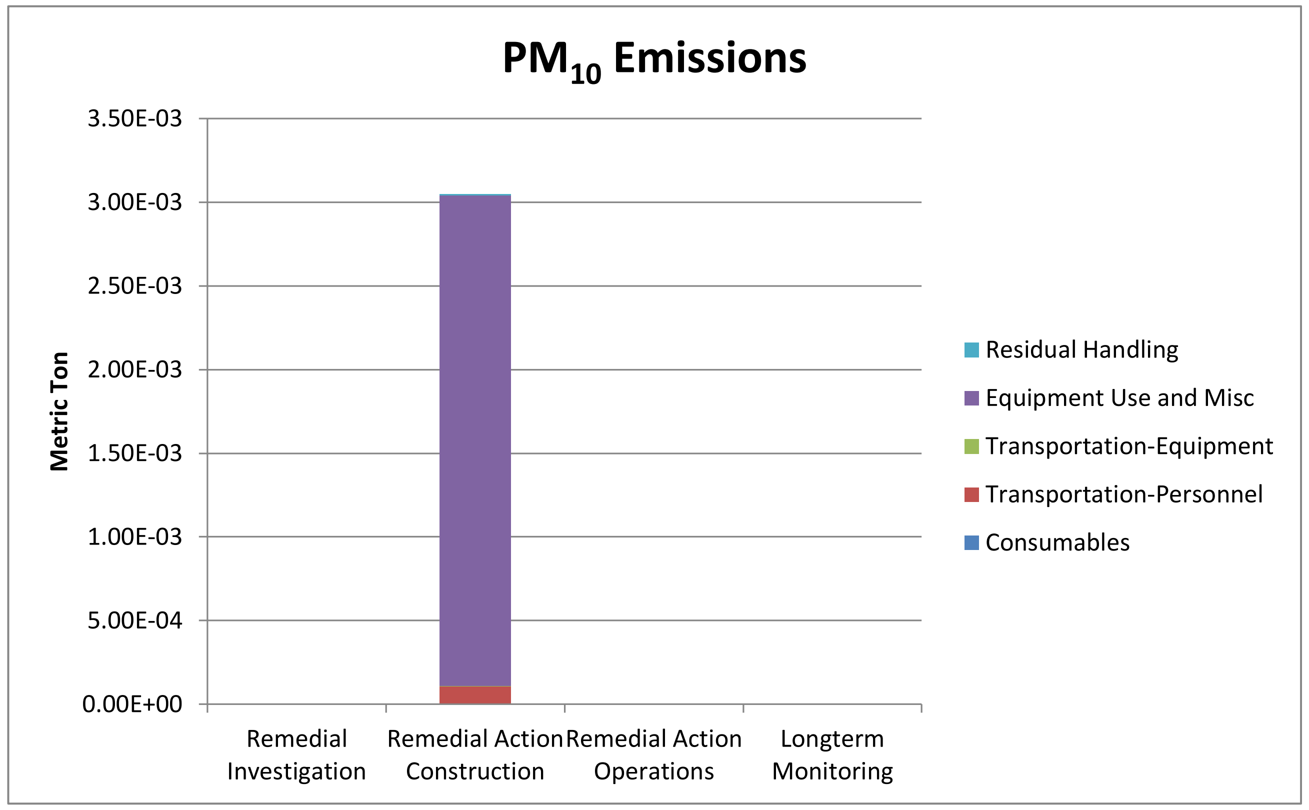

GHG Emissions
Metric Tons
250.00
200.00
150.00
100.00
50.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

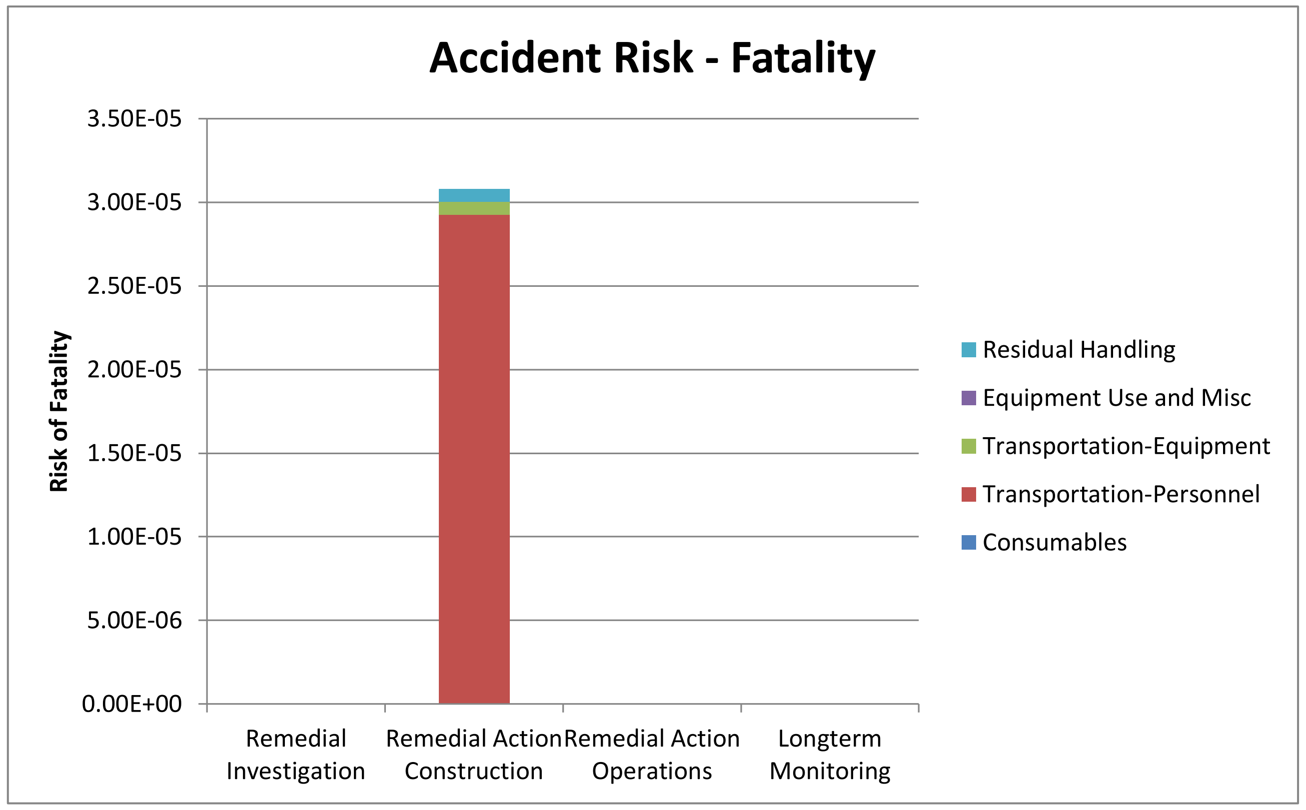

Total Energy Used
MMBTU
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

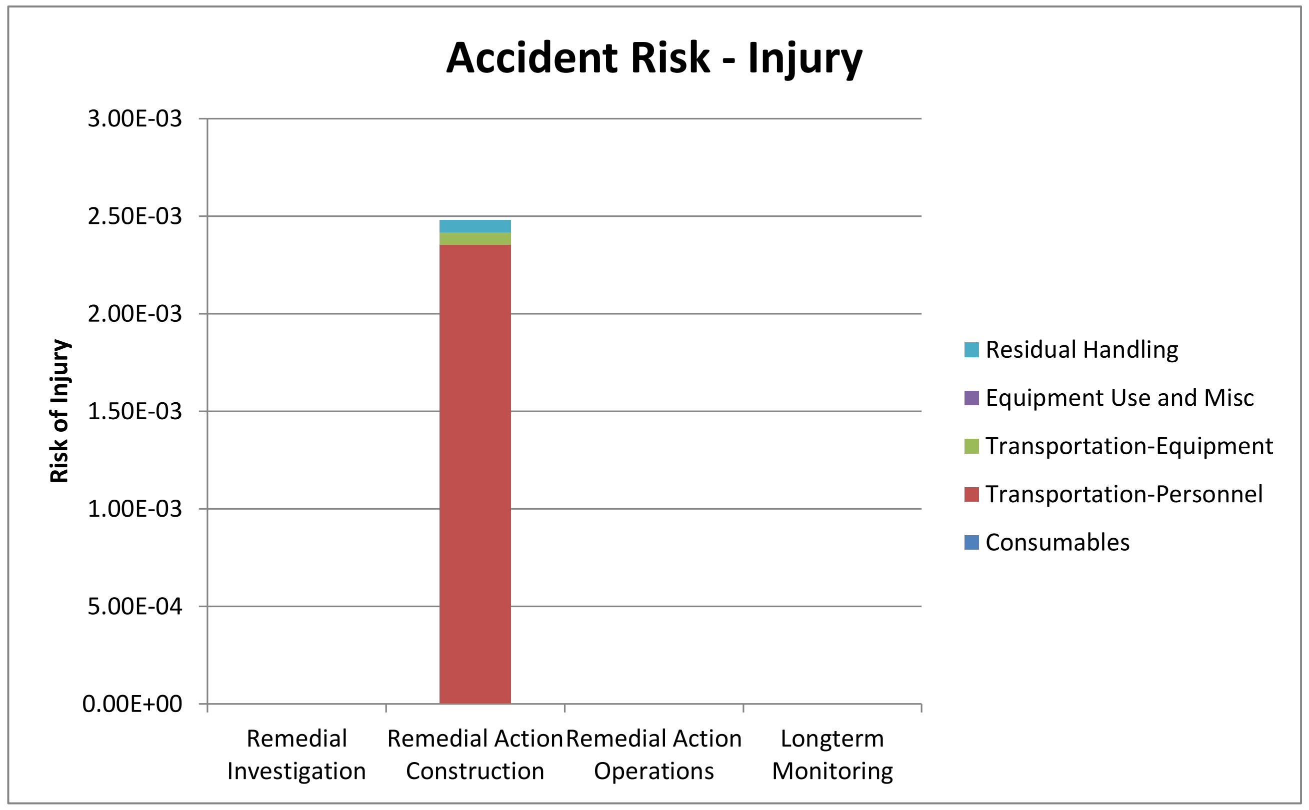

Water Consumption
Gallons
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.20E-01
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.50E-05
3.00E-05
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

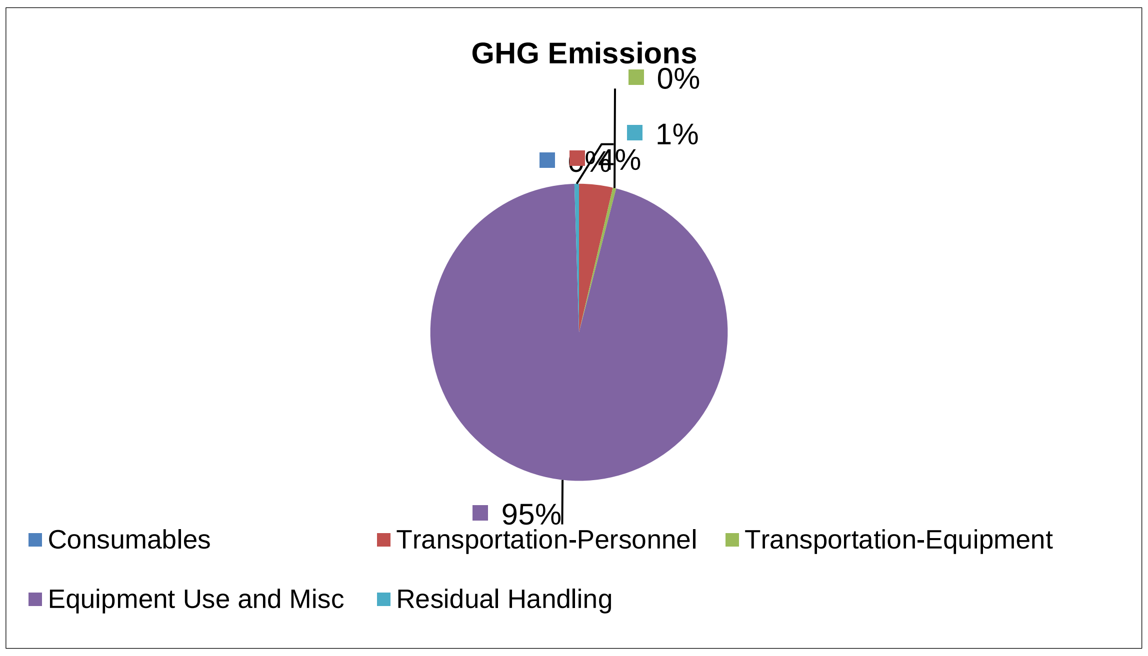

Accident Risk - Injury
Risk of Injury
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

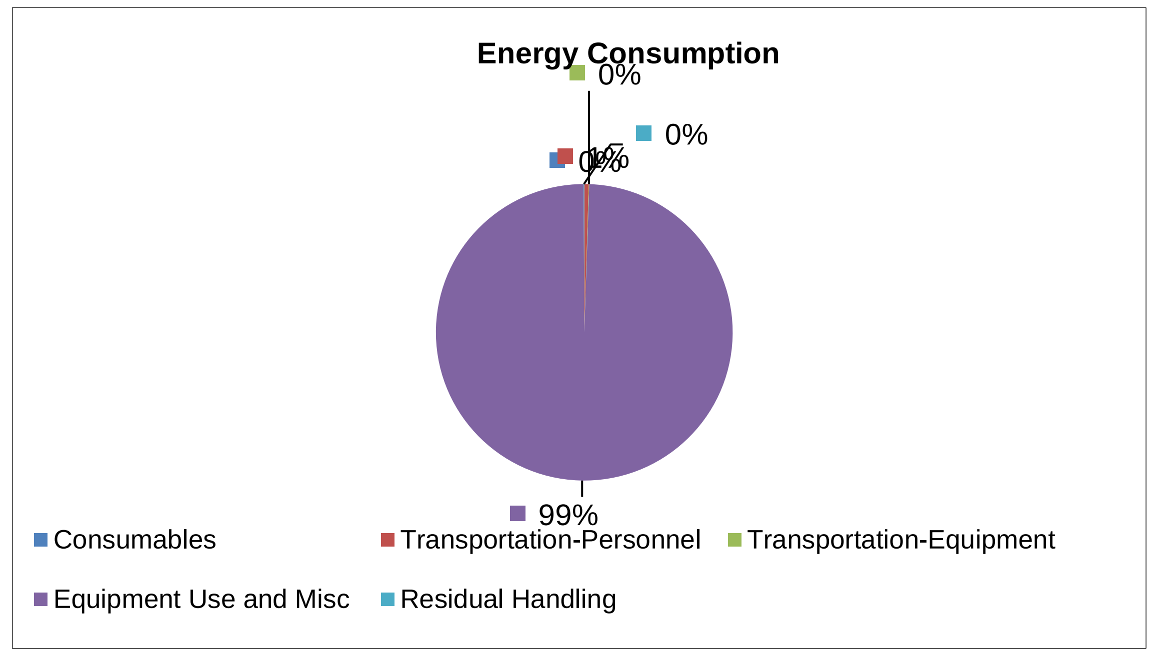
Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	Materials								Tonnes				MWhr	gal x 1000
RAC	solvent wells	PVC	2 inch dia, PVC, 0.72 lbs/ft	900.00	lft	1.46	0.73	0.00	0.01	0.00	0.00	0.00	26.79	1.11
RAC	Equipment Decon Pad	HDPE	assume HDPE, 20ft X 20ft, 6 mm thick, 0.95 g/cm3	466.98	lbs	1.04	0.55	0.00	0.00	0.00	0.00	0.00	6.11	0.17
RAC	Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (25ftx25ft pad) 80 ft of timber, density for pine 530 kg/m3	1,471.00	lbs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.01
RAC	Ion Exchange Resin	Ion Exchange Resin	ion exchange resin	19,500.00	lbs	32.99	32.99	0.00	0.00	0.00	0.00	0.00	1041.10	0.00
RAC	Monitoring Wells Head Compl	PVC	4 well heads, Assume PVC, 5 lb per head	20.00	lbs	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.83	0.03
	Subtotal					**35.55**	**34.31**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**1074.85**	**1.33**
	Construction Equipment								Tonnes				MWhr	gal x 1000
RAC	Drilling Monitoring wells	Drill Rig, DPT (diesel)	4 wells, 80% utilization	128.00	hrs	2.05	2.00	0.00	0.00	0.02	0.00	0.00	15.64	
	Subtotal					**2.05**	**2.00**	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**	**15.64**	**0**
	Operating Consumption						Tonnes						MWhr	gal x 1000
	Input Into Sitewise													0
						0	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**	**0**
				Total		**38**	**36**	**0.00**	**0.02**	**0.02**	**0.01**	**0.00**	**1,090**	**1**

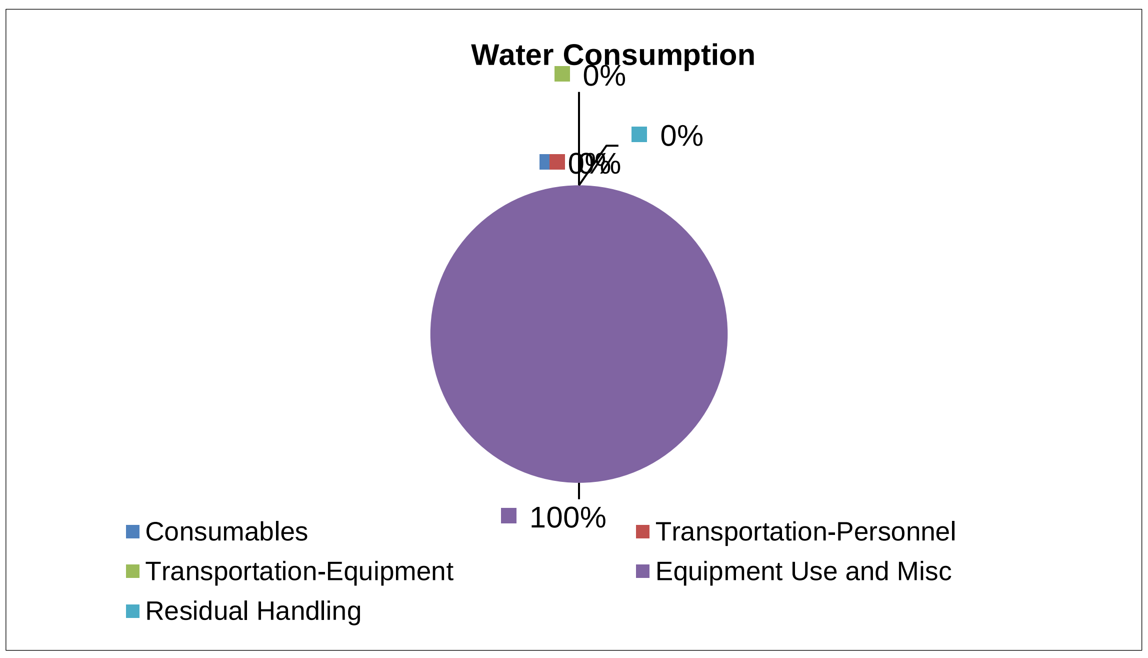
Alternative 1
Values Input into SiteWise as "Other"

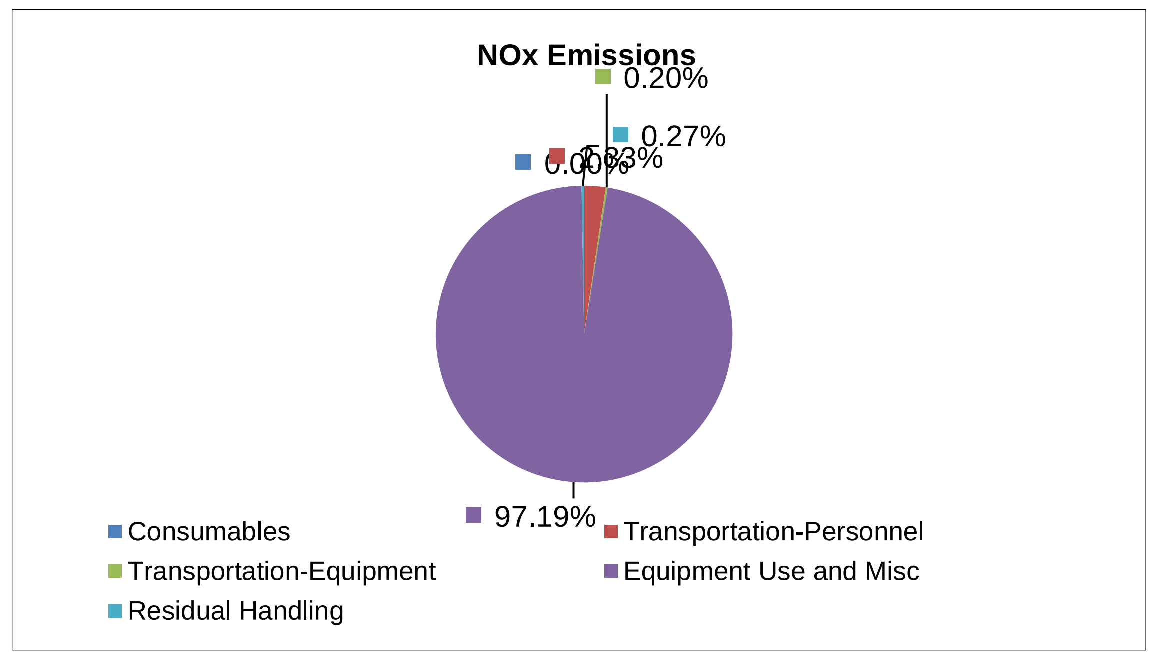
Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				MMBTU	gal
RI	-	-	-	-	-	-	-	-	-
RAC	37.60	36.31	0.97	0.32	0.02	0.01	0.00	3,720.76	1,326.53
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

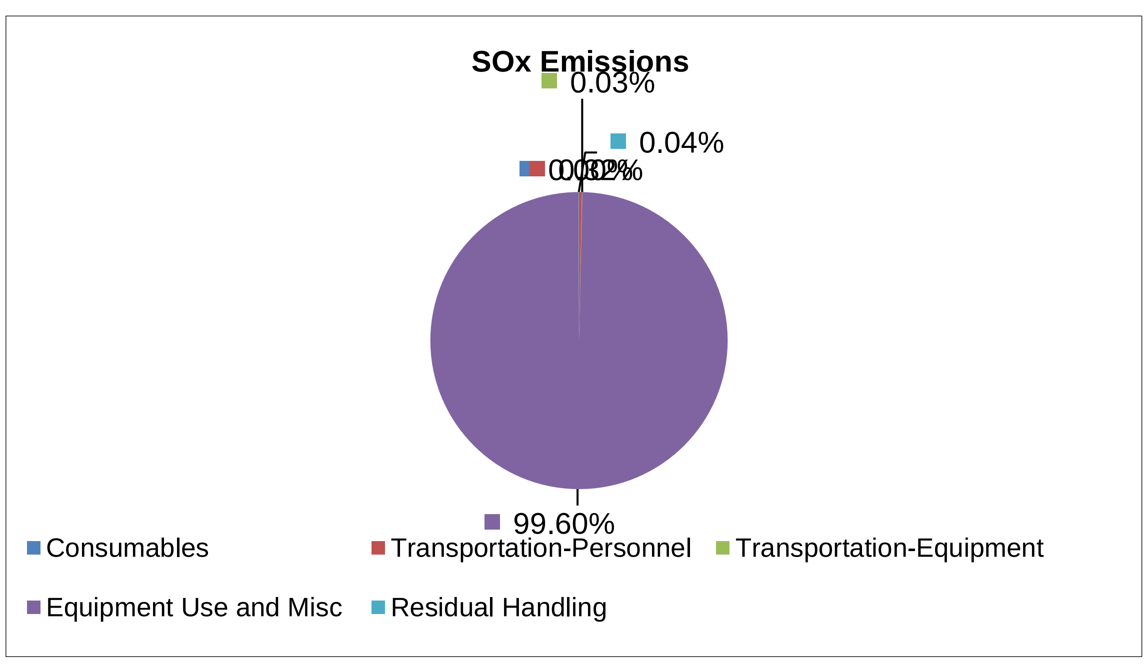
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

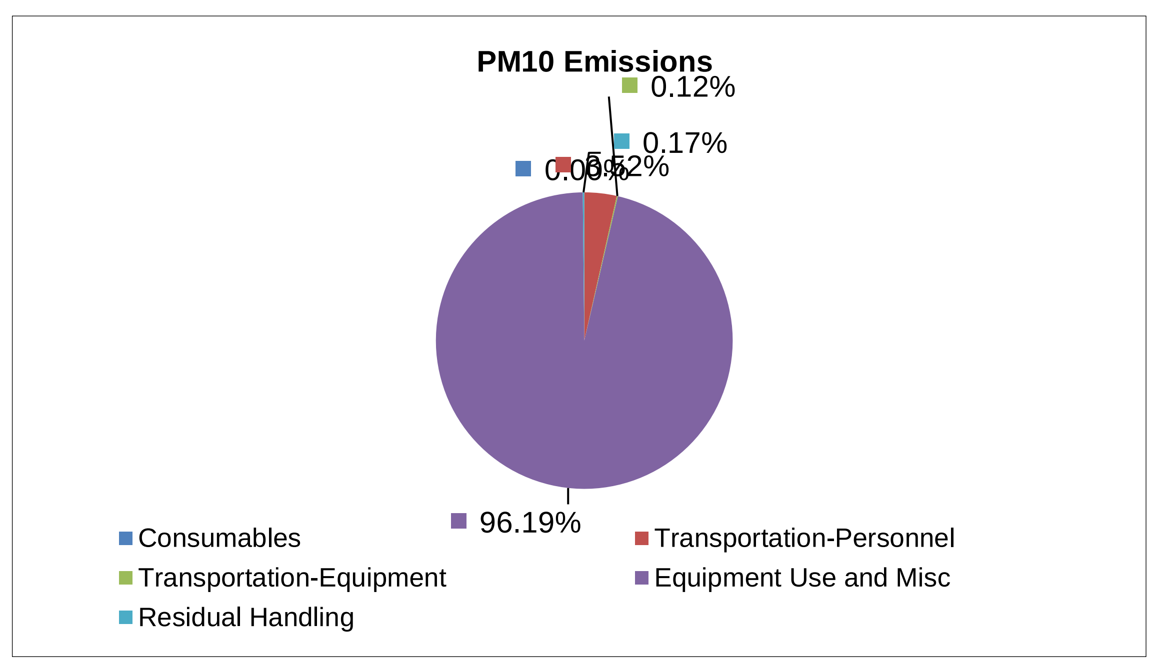

GHG Emissions
0%
1%
95%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

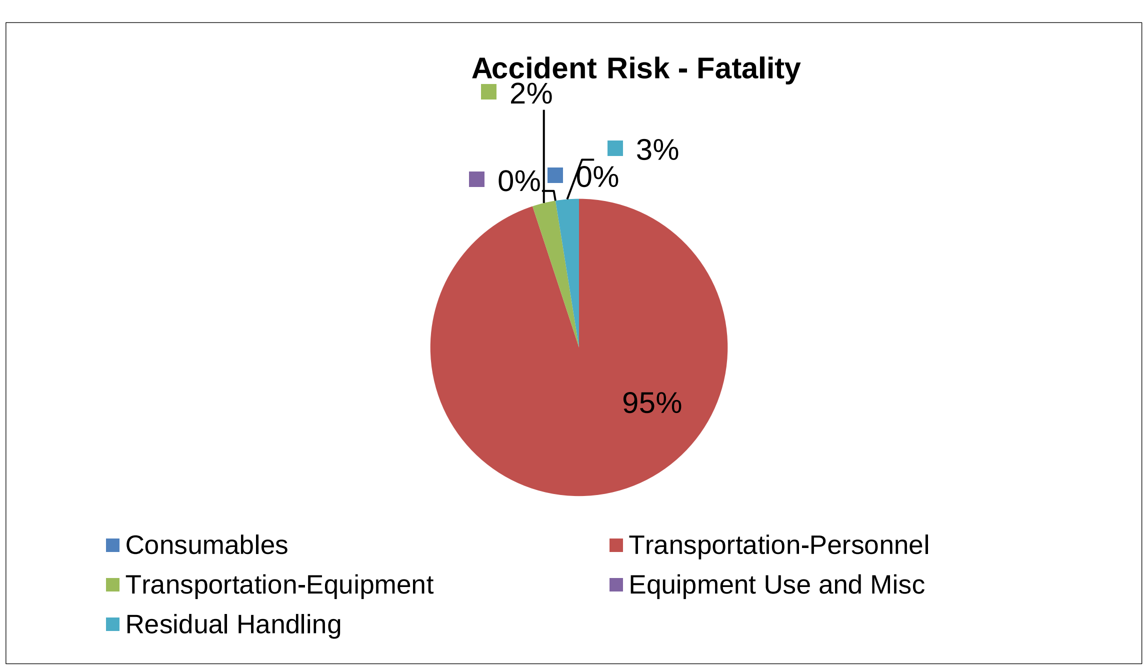

Energy Consumption
0%
0%
99%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

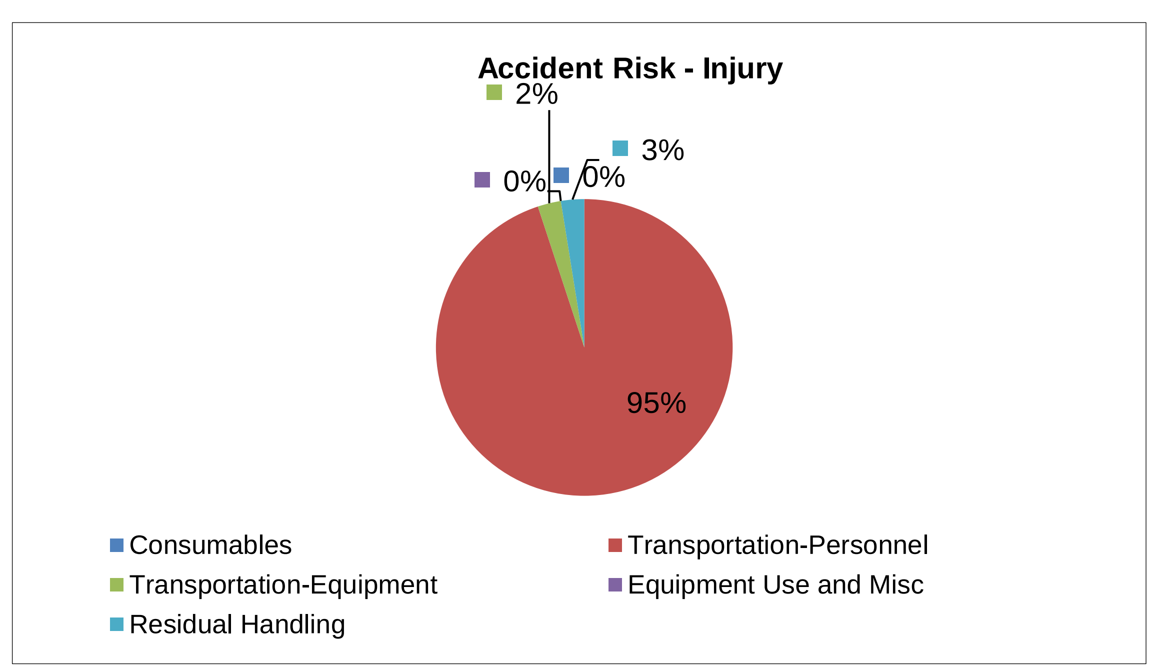

Water Consumption
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.20%
0.27%
97.19%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


SOx Emissions
0.03%
0.04%
99.60%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


PM10 Emissions
0.12%
0.17%
96.19%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
2%
3%
0%
0%
95%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

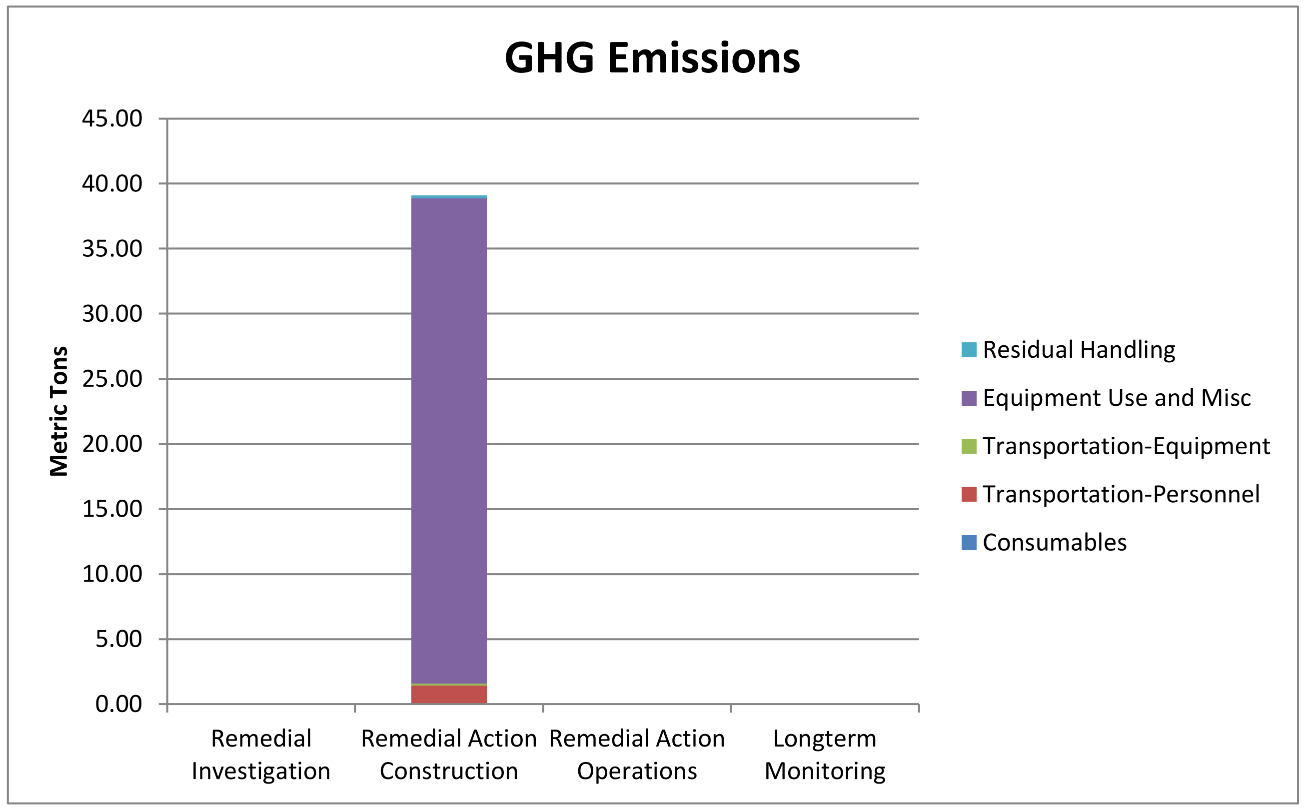

Accident Risk - Injury
2%
3%
0%
0%
95%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

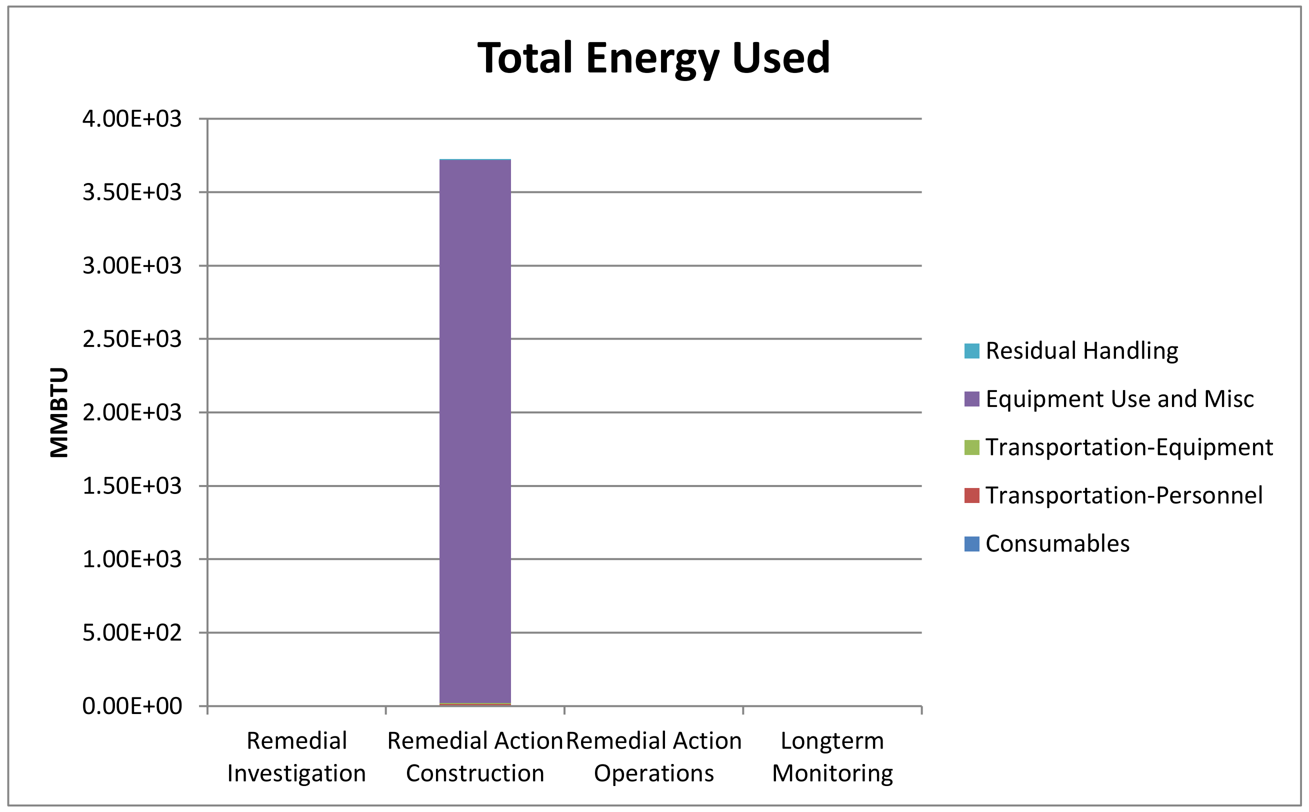
Sustainable Remediation - Environmental Footprint Summary

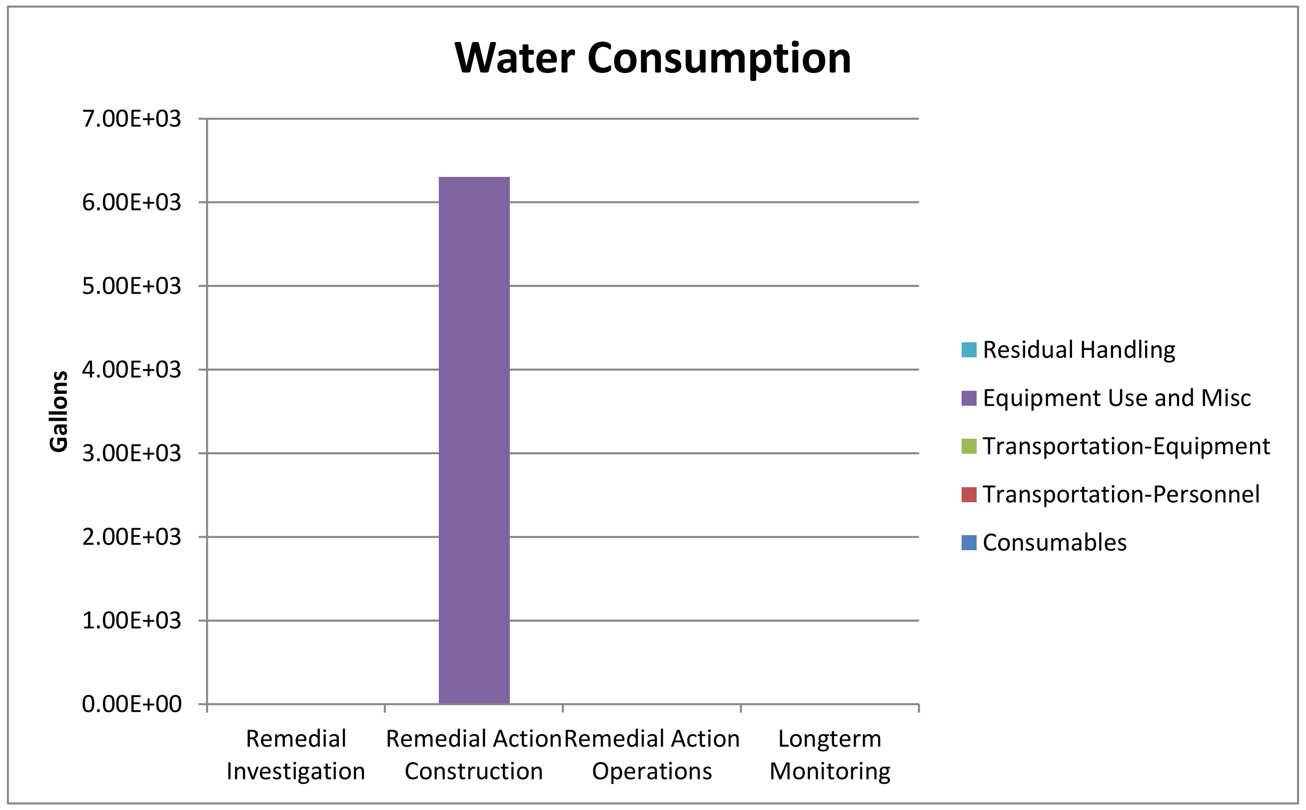
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.43	1.8E+01	NA	5.3E-04	1.9E-05	1.1E-04	2.9E-05	2.4E-03
	Transportation-Equipment	0.14	2.0E+00	NA	4.6E-05	1.9E-06	3.7E-06	7.8E-07	6.3E-05
	Equipment Use and Misc	37.30	3.7E+03	6.3E+03	2.2E-02	5.7E-03	2.9E-03	0.0E+00	0.0E+00
	Residual Handling	0.19	2.6E+00	NA	6.2E-05	2.5E-06	5.0E-06	7.8E-07	6.3E-05
	Sub-Total	39.07	3.72E+03	6.30E+03	2.27E-02	5.73E-03	3.05E-03	3.08E-05	2.48E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total		**3.9E+01**	**3.7E+03**	**6.3E+03**	**2.3E-02**	**5.7E-03**	**3.0E-03**	**3.1E-05**	**2.5E-03**

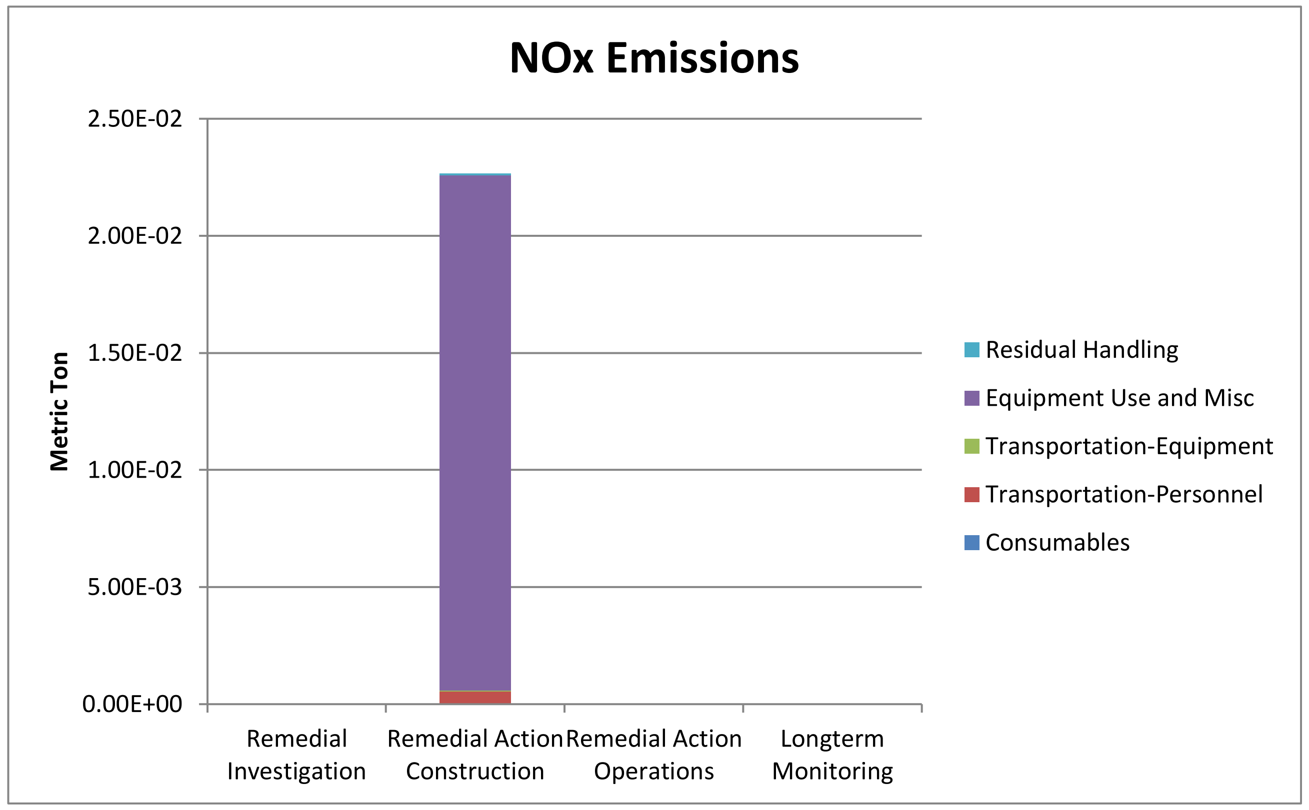
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	2.0E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**2.0E-02**

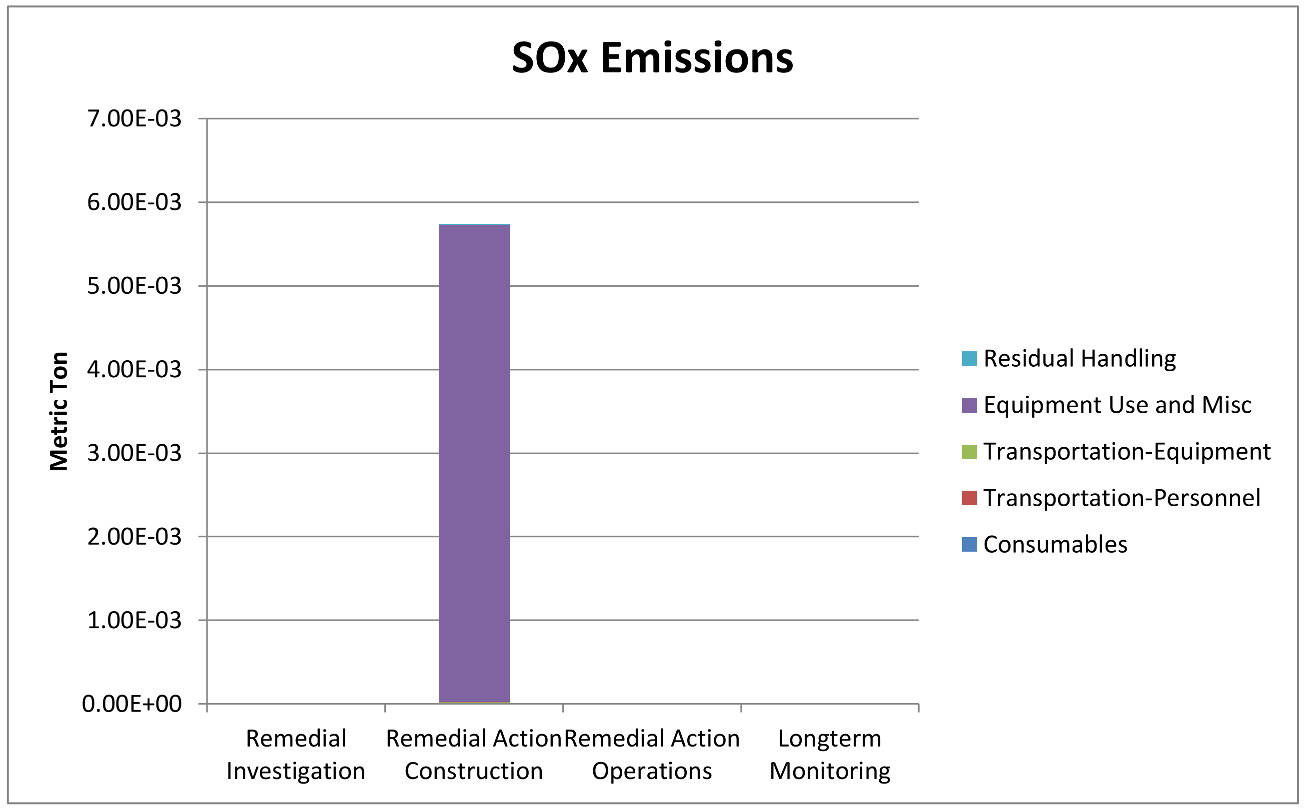
Total Cost with Footprint Reduction
$0

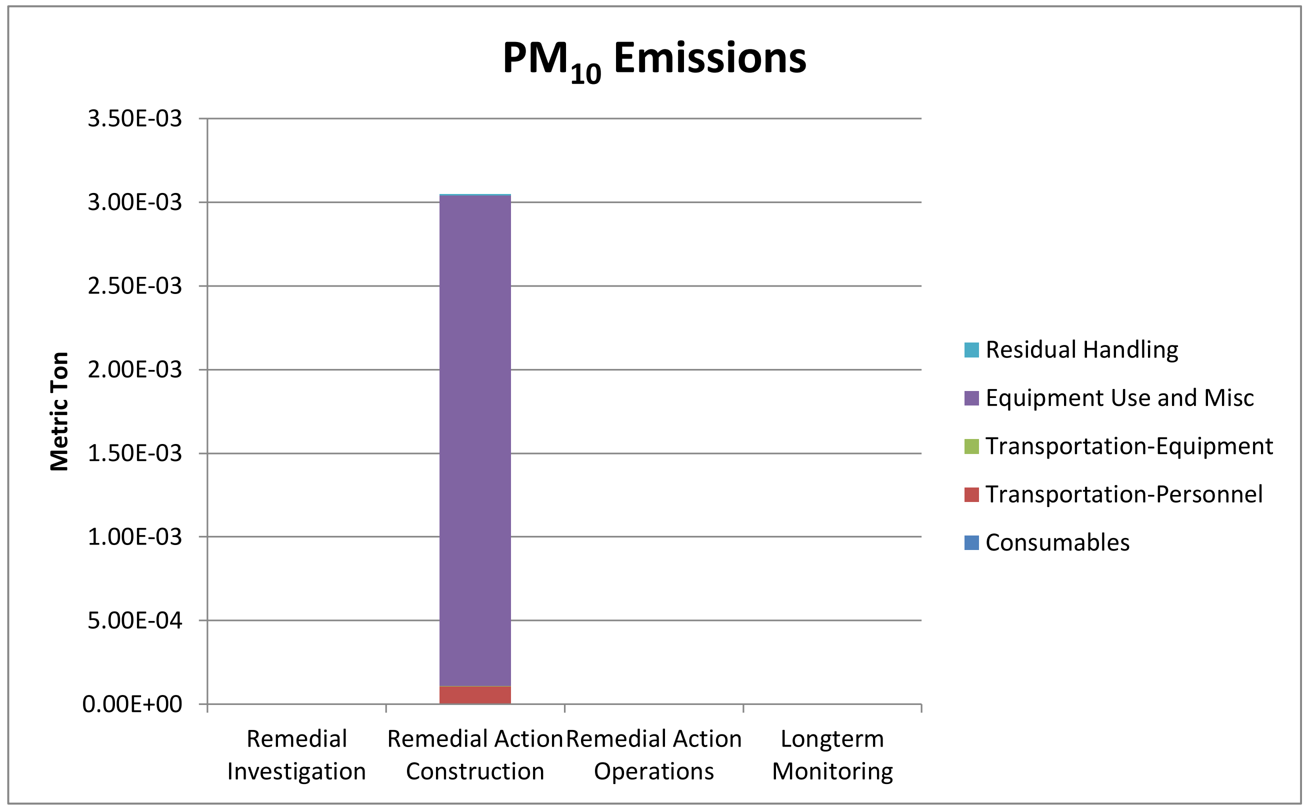

GHG Emissions
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Metric Tons
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

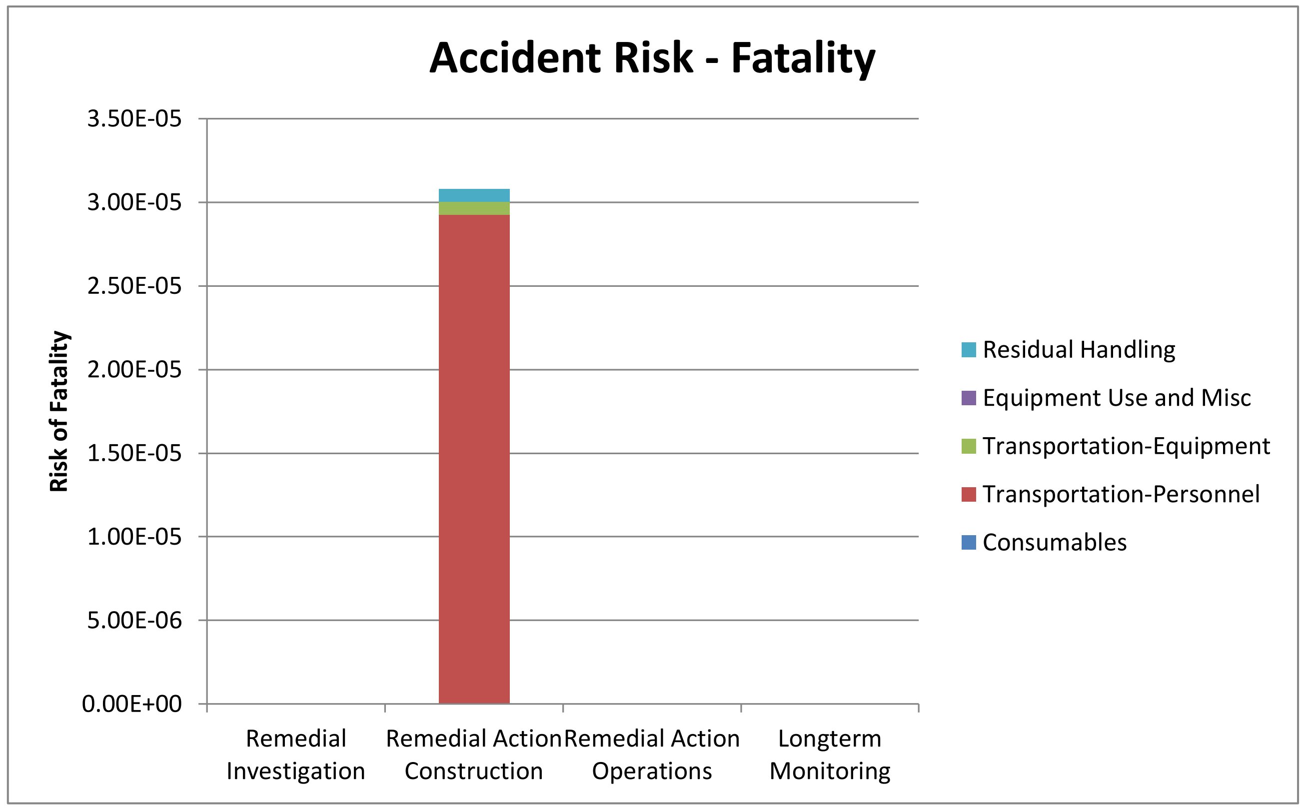

Total Energy Used
4.00E+03
3.50E+03
3.00E+03
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
MMBTU
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

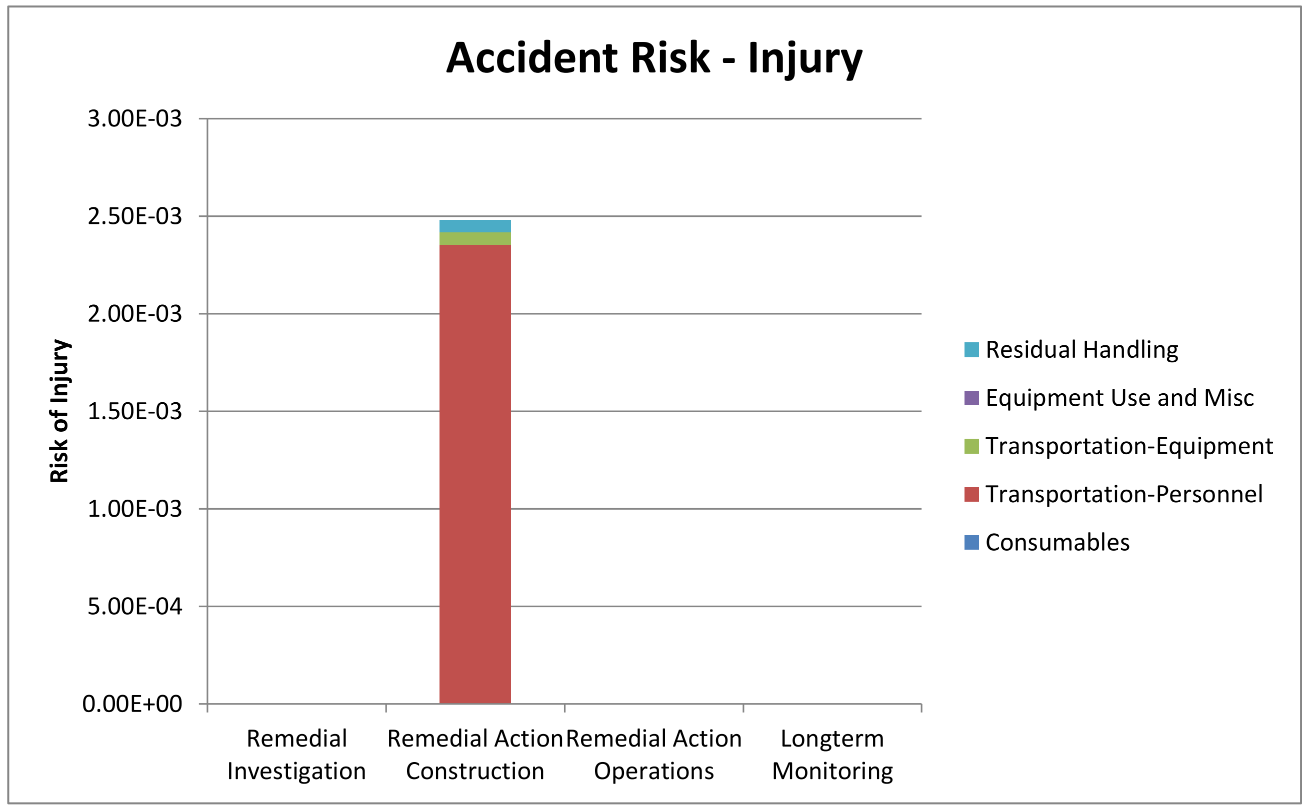

Water Consumption
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Gallons
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Metric Ton
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
7.00E-03
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.50E-05
3.00E-05
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables